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DEPARTMENT OF NUTRITION AND DIETETICS

Homemade Non-Alcoholic Fermented Beverages.

Perspectives and Consumers' Attitudes in Modern European Societies

Ph.D. Thesis

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Historical influences on traditional foods

"The history of a society's food is useful in highlighting the interdependence, delicate balance and, at times, tension over efforts to safeguard cultural identity whilst allowing and promoting cultural diversity"

Terry Davis, Secretary General of the Council of Europe

(Davis 2005, p.9)

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Abstract in English

Introduction: A growing interest in the preparation and consumption of homemade foods and beverages is currently being observed among people in urban centers. Fermented food and beverages, prepared traditionally and in a home-scale basis, have contributed to raw food preservation and at the same time production of new foods with variable sensorial characteristics, as well as enhanced nutritional value. Non-alcoholic fermented beverages (NAFB) have received rather little attention by consumers and scientists alike, especially with regards to their diversity, traditional uses, as well as, the perspectives and consumers' attitudes among modern European populations for these beverages.

Purpose of the thesis: The present thesis aimed at adding to the understanding on the role that NAFB hold in the nutrition of European populations. The diversity of the products consumed and the factors which are responsible for this diversity were examined. This thesis also aimed at contributing to the ongoing research related to the nutritional and health benefits of NAFB, through a synthesis of the available evidence. As of today, many types of NAFB remain limited to a home-scale production. Moreover, this research aimed at documenting and evaluating the attitudes, beliefs and concerns of people who undertake the production of NAFB at home.

Material and methods: A synthesis of data derived from studies within diverse scientific disciplines was undertaken in order to provide documentation regarding the dietary role, nutrient composition, health benefits and other relevant aspects of diverse ethnic, NAFB consumed by European populations. A valid and representative sample of 20 websites, blogs and forums was obtained as a result of the application of an extensive first- and second-generation sampling methodology and a detailed coding manual. Their variables and features were recorded and evaluated within a time-period of six months. Information from 2.349 on-line comments related to homemade NAFB and posted within a time-period of 12 months was recorded and analyzed. The main concerns and motivations of people interested in these beverages were evaluated using a content analysis design.

Results: Our research has shown that the NAFB, both traditional foods, as well as novel foods, used in the various European regions are very diversified. The variety of NAFB was observed both at the substrate, as well as the microbial level. Researched based evidence on their health benefits focused mainly on fermented milks (especially for kefir) and their ability to modulate gut microbiota. A body of evidence supports the hepatoprotective, immunoprotective, antioxidant, antitumor and antimicrobial properties of kombucha. The analysis and systematic evaluation of the visitors' on-line comments revealed 11 general themes, with the methodology of preparation and preservation, organoleptic characteristics, as well as health and nutritional information being the most common. Overall, the on-line comments addressed concerns about health and preventive nutrition, ethical and cultural issues, NAFB as homemade food, as well as, the use of Web as a promotion tool. Modern home fermenters share concerns, such as the evidence-based health effects of the NAFB they chose to produce, with an emphasis on gastrointestinal, liver, immune and cardiovascular health.

Key words: homemade, non-alcoholic, fermented beverages, European, internet

Abstract in Greek

Εισαγωγή: Στη σύγχρονη εποχή παρατηρείται ένα αυξανόμενο ενδιαφέρον για την προετοιμασία και κατανάλωση τροφίμων και ποτών οικιακής παρασκευής. Τα ζυμούμενα τρόφιμα και ποτά, ως παραδοσιακά ή οικιακής παρασκευής προϊόντα, συμβάλλουν στην συντήρηση του μη επεξεργασμένου φαγητού, καθώς και στην παρασκευή τροφίμων τόσο με ποικίλα οργανοληπτικά χαρακτηριστικά, όσο και με πρόσθετη διατροφική αξία. Τα μη αλκοολούχα ζυμούμενα ποτά (ΜΑΖΠ) έτυχαν μάλλον λίγης προσοχής τόσο από τους καταναλωτές, όσο και από τους επιστήμονες, ιδίως όσον αφορά στην ποικιλία τους, στις παραδοσιακές τους χρήσεις, καθώς και στις προοπτικές και απόψεις των σύγχρονων Ευρωπαϊκών πληθυσμών για τα συγκεκριμένα ποτά.

Σκοπός της διδακτορικής διατριβής: Η παρούσα διδακτορική διατριβή είχε ως στόχο την κατανόηση του ρόλου που διαδραματίζουν τα ΜΑΖΠ στη διατροφή των Ευρωπαϊκών πληθυσμών. Συγκεκριμένα εξετάστηκε η ποικιλία των προϊόντων που καταναλώνονταν, καθώς και οι παράγοντες που ευθύνονται για την ποικιλία τους. Η συγκεκριμένη διατριβή είχε επίσης ως στόχο την συμβολή στην τρέχουσα έρευνα σχετικά με τα οφέλη των ΜΑΖΠ στην διατροφή και την υγεία, μέσω σύνθεσης των διαθέσιμων ερευνητικών δεδομένων. Στις μέρες μας αρκετά ΜΑΖΠ περιορίζονται σε προϊόντα οικιακής παρασκευής. Πρόσθετα, η συγκεκριμένη έρευνα είχε ως στόχο την καταγραφή κι αξιολόγηση των απόψεων, πεποιθήσεων κι ανησυχιών των ατόμων που παρασκευάζουν ΜΑΖΠ σε οικιακή βάση.

Υλικό και μέθοδοι: Πραγματοποιήθηκε σύνθεση ερευνητικών δεδομένων μελετών προερχόμενες από διάφορους επιστημονικούς κλάδους, προκειμένου να καταγραφεί ο διαιτητικός ρόλος, η διατροφική σύσταση, τα οφέλη για την υγεία και άλλες συναφείς πτυχές διαφόρων εθνικών, ΜΑΖΠ, που καταναλώνονται από Ευρωπαϊκούς πληθυσμούς. Ως αποτέλεσμα της εφαρμογής μιας εκτεταμένης μεθοδολογίας δειγματοληψίας πρώτης και δεύτερης γενιάς και ενός λεπτομερούς εγχειριδίου κωδικοποίησης προέκυψε ένα έγκυρο και αντιπροσωπευτικό δείγμα 20 ιστοτόπων, ιστολογίων και διαδικτυακών τόπων συζήτησης. Οι μεταβλητές και τα χαρακτηριστικά τους αξιολογήθηκαν για χρονικό διάστημα έξι μηνών. Εντός χρονικού διαστήματος 12 μηνών, καταγράφηκαν και αναλύθηκαν πληροφορίες από 2.349 ηλεκτρονικά σχόλια που περιλαμβάνονταν στους 20 ιστότοπους, ιστολόγια και διαδικτυακούς τόπους συζήτησης σχετικά με τα ΜΑΖΠ οικιακής παρασκευής. Οι κυριότερες ανησυχίες και τα κίνητρα των ατόμων που ενδιαφέρονταν για τα συγκεκριμένα ποτά αξιολογήθηκαν, χρησιμοποιώντας ένα σχεδιασμό ανάλυσης περιεχομένου.

Αποτελέσματα: Η έρευνά μας έδειξε ότι τόσο τα παραδοσιακά, όσο και τα καινοφανή ΜΑΖΠ που καταναλώνονται από Ευρωπαϊκούς πληθυσμούς εμφανίζουν μεγάλη ποικιλία, η οποία παρατηρήθηκε τόσο σε επίπεδο υποστρώματος, όσο και μικροοργανισμών. Τεκμηριωμένα ερευνητικά δεδομένα σχετικά με τα οφέλη για την υγεία αφορούσαν κυρίως στα ζυμούμενα γάλατα, όπως το kefir και ως επί το πλείστον στην ικανότητά τους να ρυθμίζουν τη μικροβιακή χλωρίδα του εντέρου. Σημαντικός αριθμός τεκμηριωμένων επιστημονικών δεδομένων υποστηρίζει τις ηπατοπροστατευτικές, ανοσοπροστατευτικές, αντιοξειδωτικές, αντινεοπλασματικές και αντιμικροβιακές ιδιότητες της kombucha. Η ανάλυση και συστηματική αξιολόγηση των διαδικτυακών σχολίων των επισκεπτών ανέδειξε 11 θεματικές ενότητες, με επικρατέστερες τη μεθοδολογία παρασκευής και συντήρησης, τα οργανοληπτικά χαρακτηριστικά, την υγεία και τις διατροφικές πληροφορίες για τα συγκεκριμένα ποτά. Συνολικά, τα διαδικτυακά σχόλια αφορούσαν ανησυχίες των επισκεπτών για την υγεία και την προληπτική διατροφή, ηθικά και πολιτισμικά θέματα, την χρήση των ΜΑΖΠ ως τρόφιμα οικιακής παρασκευής, καθώς και τη χρήση του διαδικτύου ως εργαλείο προώθησης. Οι

σύγχρονοι άνθρωποι που παρασκευάζουν ΜΑΖΠ σε οικιακή βάση, μοιράζονται ανησυχίες που σχετίζονται με τα επιστημονικώς τεκμηριωμένα οφέλη για την υγεία των ΜΑΖΠ, με έμφαση στην καλή λειτουργία του γαστρεντερικού, ηπατικού, ανοσοποιητικού και καρδιαγγειακού συστήματος.

Λέξεις-κλειδιά: οικιακής παρασκευής, μη αλκοολούχα, ζυμούμενα ποτά, Ευρωπαϊκός, διαδίκτυο

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ABBREVIATIONS

HFBs	Homemade foods and beverages
NAFB	Non-alcoholic fermented beverages
ΤΠΟΠ	Τρόφιμα και ποτά οικιακής παρασκευής
ΜΑΖΠ	Μη αλκοολούχα ζυμούμενα ποτά
TFBs	Traditional foods and beverages
EuroFIR	European Food Information Resource
GNPD	Global New Products Database
FAO	Food and Agriculture Organization
PDO	Protected designation of origin
EU	European Union
Truefood	Traditional United Europe Food
PGI	Protected geographical indication
PDO	Protected designation of origin
TSG	Traditional specialty guaranteed
SD	Standard deviations
LAB	Lactic acid bacteria
GRAS	Generally Accepted As Safe
CLA	Conjugated linoleic acid
RCTs	Randomized controlled trials
NCM	Non-cow milk

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

1.1 Consumer preferences in modern European societies: The case of traditional and homemade foods and beverages

1.1.1 Traditional foods and beverages (TFBs)

TFBs are important parts of European culture, identity, and heritage of gastronomy (European Commission, 2007). They contribute to the development and sustainability of rural regions, entail substantial product differentiation (Avermaete et al., 2004) and provide food variability for citizens. TFBs are mainly produced in European market by small- and medium-sized enterprises, which in general are not equipped with a specialized marketing and communication business unit. For this reason, consumers' beliefs, perceptions, and expectations towards those enterprises should be carefully understood in order to develop new products and to implement successful marketing actions.

In Europe, traditional cuisines include traditional foods from different regions that have been influenced by many factors (European Food Information Resource [EuroFIR], 2009). Firstly, the availability of raw materials and generally the agricultural habits and the location had a major role in this field. Another factor that has influenced the dietary patterns of its inhabitants is their history and culture. Different cultures, for example the Turks, that have occupied many countries across Europe for a period of time, have put their cultural signature in the gastronomy of the country they concurred. Other cultures, such as Jewish people, have also influenced the traditional foods in many parts of Europe without occupying the country they lived. Furthermore, borders across Europe have changed many times over the years, resulting to a cultural and gastronomy exchange/interaction among different societies.

The discovery of the New World and the blooming of the international trade have been important factors in enriching the diversity of traditional foods across Europe. Non-available foods in the past, such as potatoes, maize, sunflowers, pumpkins (marrows), sweet potatoes, Jerusalem artichoke, vanilla, and tomatoes, have become integral part of many European traditional dishes. Finally, different religions have influenced traditional foods and culinary rules across Europe. Christians, Muslims and Jewish people have certain dietary rules and food taboos, although they have co-exist for centuries in many European counties (Parasecoli, 2005).

To date, there is a trend of citizens' resistance to an increasing globalization and industrialization of the food sector. As a result, consumers are interested in TFBs as a food product category (Jordana, 2000). According to the Global New Products Database (GNPD) from Global Food and Drink Trends 2017 report (Global Food and Drink Trends, 2017), between September 2010-

August 2011 and September 2015-August 2016, there was a 269 % increase in global food and drink launches describing their products as “ancient”. Such “ancient” items include ancient grains, but they also tap into the potential of ancient recipes, practices, and traditions. Furthermore, Innova Market Insights identified the Top Trends for 2017 from its ongoing analysis of key global developments in food and drink product launches worldwide (Innova Market Insights, 2016). According to this analysis, nowadays, ethnic flavors are still popular among consumers, even in very young ages. TFBs using specific ethnic ingredients based on global influences are very popular in Europe.

Although the term ‘traditional foods’ is used widely there are hardly any definitions that clearly describe traditional foods (EuroFIR, 2009). Nowadays, definitions for TFBs have been created mainly from food scientists or food technologists (**Table 1**). One example is the EuroFIR Traditional Foods project, which attempted and developed a definition of the term ‘traditional foods’ (Trichopoulou et al., 2007) acknowledged by the Food and Agriculture Organization of the UN (FAO) at the 26th FAO Regional conference for Europe in Innsbruck, Austria, on the 26th-27th June 2008. But all these efforts have proven to be challengeable for some reasons. Generally, traditional food is a relative rather than absolute idea (Nosi and Zanni, 2004), whose range of foods continually evolves and grows (Wycherley et al., 2008). That is the reason why there is diversity of food product examples of traditional foods. Kuznesof et al. (1997) state that examples of traditional foods are “products with a protected designation of origin (PDO)” and also “poorer people’s food” and “old-fashioned food”.

Table 1. Published definitions of the concept of traditional food according to the Truefood consumer studies of 2006-2007

Definition of the concept of traditional food	Reference
A traditional food product is a representation of a group, it belongs to a defined space, and it is a part of a culture that implies the cooperation of the individuals operating in that territory.	Bertozzi (1998)
In order to be traditional, a product must be linked to a territory, and it must also be part of a set of traditions, which will necessarily ensure its continuity overtime.	Jordana (2000)
Traditional means proven usage in the community market for a time period showing transmission between generations; this time period should be the one generally ascribed as one human generation, at least 25 years	EU (2006)
Traditional food is a food of a specific feature or features, which distinguish it clearly from other similar products of the same category in terms of the use of traditional ingredients (raw materials or primary products) or traditional composition or traditional type of production and/or processing method	EuroFIR (2007)
TFPs are agri-food products whose methods of processing, storage, and ripening are consolidated with time according to uniform and constant local use	Ministero Agricoltura (1999)

Furthermore, a wide variety of terms or designations are used for specific foods with characteristics of traditional food. Characteristic examples are: “local food” (Chambers et al., 2007; Lobb and Mazzocchi, 2007; Roininen et al., 2006), “original food” (Cembalo et al., 2008), “regional food” (Kuznesof et al., 1997), “typical food” (Caporale et al., 2006; Iaccarino et al., 2006; Nosi and Zanni, 2004; Platania and Privitera, 2006), “specialty food” (Guinard et al., 1999; Schamel 2007; Stefani et al., 2006; Wycherley et al., 2008), and “traditional (agri-)food” (Cayot, 2007; Jordana, 2000; Sanzo et al., 2003). Also, different

motivations to purchase and consume TFPs exist among citizens (Platania and Privitera, 2006), which associate with different perceptions and conceptions of what consumers assume to be traditional. As a conclusion, citizens' perceptions and concepts of TFBs are very important in order to develop future products and to schedule market positioning, and marketing communication related to this food category. Finally, Europe is a heterogeneous food consumption area (Askegaard and Madsen, 1998). According to Jordana (2000), southern European countries keep a more traditional food character, since they have many small-sized companies and a warmer climate, that favour an expansive availability of TFBs. Montanari (1994) also showed that urban citizens might be more rural-based consumers, while according to Weatherell et al. (2003) rural-based consumers tend to show a greater interest in TFBs.

Regarding citizens preferences about TFBs in modern European societies, an EU funded, integrated research project Truefood (Traditional United Europe Food) was performed within the EU as part of its 6th Framework Program for Research, Technology Development, and Demonstration (Guerrero et al., 2009). This study included many European countries with different culture, geographical location, market presence of TFBs, and familiarity with EU food quality certification labels (Becker, 2009; Verbeke et al., 2012). According to the findings of this study, Italy, France, and Spain had 227, 183, and 148 European Commission- registered products with geographical indications (protected designation of origin, PDO), protected geographical indication (PGI), and traditional specialty guaranteed (TSG), respectively. On the contrary, in Belgium and Poland the number for the above products did not exceed the 12 in May 2011 (EU DOOR, 2011). The above numbers had increased to 273, 220, and 182 in Italy, France, and Spain, respectively, by May 2015 (EU DOOR, 2015).

Another finding of this project was that citizens define TFBs according to four main dimensions (Guerrero et al., 2009). The first dimension was called "*habits and natural*", since TFBs were considered food products that are part of daily life and that are consumed every day or very often. Also, TFBs were related to health, to naturalness, to homemade or farm-made or minimum industrial processing or handling, to an artisan production method and without additives or preservatives. A second dimension was defined as "*origin and locality*". Traditional foods were linked to food origin and they could not be exported or transferred to other areas outside their locality. *Processing and elaboration* constituted the third dimension. A great proportion of the consumers discussed more about traditional cuisine than about TFBs, thus giving more importance to the gastronomic heritage and artisanal character of the processing and elaboration know-how. Finally, the fourth dimension was "*Sensory properties*". Sensory characteristics with

taste being the most important one are usually used in order to define the authenticity and traditional identity of a TFB.

According to the results for the qualitative consumer-driven definition of TFBs, 13 statements have been isolated and presented in **Table 2** (Vanhonacker et al., 2010a). The statement "grandparents already ate it" received the highest mean score and the statement "natural, low processed." obtained the lowest score. Based on **Table 2**, a consumer-driven definition for the concept of ''*traditional food product''* was created: " *A traditional food product is a product frequently consumed or associated to specific celebrations and/or seasons, transmitted from one generation to another, made in a specific way according to gastronomic heritage, naturally processed, and distinguished and known because of its sensory properties and associated to a certain local area, region or country* " (Vanhonacker et al., 2010a).

Table 2. Consumers' statements depicting the concept of TFBs

Statement
• When I think about traditional food, I think about food products that my parents and *grandparents already ate* , i.e., food that has been available for a long time
• I consider traditional food as *well-known* food
• Traditional food has an *authentic recipe* , i.e., an original, since long known recipe
• To me, a traditional food product is associated with *specific sensory properties*
• The availability of traditional food is strongly *dependent on the season*
• A traditional food product is typically produced *in grandmothers' way*
• Traditional food has an *authentic origin of raw material* , i.e., use of the same kindof raw material as originally used when the product was developed
• According to me, traditional food is typically something one *can eat very often*
• Traditional food has an *authentic production process* , i.e., following the original production process, established when the product was developed
• A traditional food product must *contain a story*
• The key steps of the production of traditional food must be *local*
• When I think about traditional food, I think about *special occasions* and/or celebrations
• When it comes to food products, for me traditional food means *natural , low Processed*

Cross-country differences have also been identified, thus the term “traditional food” has many different meanings across countries in the EU and should be used very carefully. In particular, Belgium TFBs were significantly associated with food and beverages that have been consumed very often and for many years, dependently on the season. In France, Italy, and Spain, consumers do not pay attention to specific elements of TFBs, where in Norway long existence and knowledge of TFBs received much emphasis while in Poland gastronomic heritage was very important.

Another finding of the study was the depiction of the character profile of the typical TFBs consumer and non-consumer (Vanhonacker et al., 2010b). It has been proposed that a typical traditional TFBs consumer was most strongly associated with “people living in the countryside” and “people loving national or regional cuisine”. As a conclusion, typical traditional European TFBs consumers prefer local products, have a preference in food preparation and consumption and usually follow a traditional way of life. On the other hand, the typical TFBs non-consumer usually had a younger age, was single, had limited time available, travel a lot, and had limited time for shopping foods and beverages and cooking.

Regarding consumer perception and image of TFBs, cross-national similarities and differences were observed. For consumers in Spain and Italy, TFBs have a good and special taste, a high and consistent quality, a good appearance, a high nutritional value, and healthiness. Belgian consumers believe that TFBs have good taste, high quality, and good availability. In France, TFBs are thought to be of high quality but rather expensive. In Poland, TFBs are regarded to have good taste, high quality, high preparation time, high prices and be environmentally friendly and supportive for the local economy. Finally, in Norway, TFBs are characterized with good taste, high quality, high safety, but with rather low healthiness and a long preparation time.

TFBs constitute an important part of the European gastronomic heritage and the profile of people consuming them depicts preference in locality, food, and tradition. Cross-cultural differences have been associated with differences in the market presence of traditional foods, as well as with differences in gastronomic cultures and eating behavior. Although there is a positive attitude for TFBs, there is still a potential for further product improvements. The development of healthier TFBs, such as low-fat and/or low-salt food products or non-alcoholic beverages, would be appealing to a large group of consumers and national markets.

1.1.2. Homemade foods and beverages (HFBs)

Nowadays the preparation and consumption of HFBs have gained ground against convenience foods or foods and beverages consumed away from home among people in urban centers (Rivera, Orias, Azapagic, 2014; Key Note, 2013). According to Mintel's 2017 Global Food and Drink Trends report from 60 global analysts, among the six key food and beverage trends to anticipate in the coming year is the category of HFBs (Global Food and Drink Trends, 2017). Mintel's forecast offers an in-depth glimpse of the future food and beverage landscape with the changes underfoot across Europe and other regions worldwide. A wide-ranging quest for authenticity and the narrative behind our food and drink products has taken craft, artisanal, and handmade items to a whole new level over the past several years. Furthermore, according to Innova Market Insights analysis, a profile of an increasingly more health-conscious consumer has been emerged (Innova Market Insights, 2016). Moreover, one of the food trends for 2017 is that consumers are increasingly personalizing their own nutrient intake, making food choices based on what they think will make them feel better. Also, the craft trend is still attractive to consumers. The idea of having foods produced as simply and as close to the farm has been gaining steam in the last few years and changing the way people think about the foods they eat and the statement "Simple eating is premium eating" has been identical to them.

During the recent years, home-based food vendors are increasing and new state laws legalize their businesses in many countries worldwide. In 2009, an addition to the Indiana Code called HEA 1309 allowed entrepreneurs to market homemade food at farmers' markets and their own roadside stands, with minimal state oversight (Indiana State Department of Health, 2009). This action was forced to ease local home-based vendors by placing less regulation and oversight on certain homemade food products. In January 2013, another law called the California Homemade Food Act was designed in order to help people increase the consumption of locally produced food (Official California Legislative Information, 2013). In Iowa, licensing is required to sell or distribute non-potentially homemade hazardous foods to places, such as restaurants, retailers, or institutions (Iowa Code, 2017). In the EU, no such food laws exist so far.

According to a study, which examined national patterns in cooking frequency and diet quality among adults in the USA, overall and by weight-loss intention and analyzed data from the 2007-2010 National Health and Nutrition Examination Survey from more than 9,000 participants aged 20 and older, people who frequently cook meals at home eat healthier and consume fewer calories than those who cook less (Wolfson and Bleich, 2015). Furthermore, when people cook most of their meals at home, they consume fewer carbohydrates, less sugar and less fat than

those who cook less or not at all – even if they are not trying to lose weight. The findings also suggest that those who frequently cooked at home – six-to-seven nights a week – also consumed fewer calories on the occasions they ate out. The researchers also found that those who cook at home more frequently rely less on frozen foods and are less likely to choose fast foods on the occasions they eat out. Moreover, blacks are more likely to live in households where cooking occurs less frequently than whites; and individuals who work more than 35 hours a week outside home cook less, as well. Another report from the industry consulting firm NPD Group, a leading global information company, has just released its 29th annual Eating Patterns in America Report and found that the number of Americans eating at restaurants in 2014 has dipped to a 20-year low, despite the ecomonic recovery (NPD Group, 2014). The report found that a decline in restaurant usage and an increase in meals from home is one of the single biggest changes in eating patterns in Americans in the last five years.

HFBs are healthier than convenience foods and beverages for many other reasons. They are usually prepared from wholesome ingredients and they require a limited use of additives. Also, they are usually free of preservatives, since they are often consumed within 1-2 days from their preparation. Another reason is that when people plan ahead, they are less tempted to eat something unhealthy. Furthermore, HFBs are usually prepared and consumed within a short period of time. Also, they give consumers the opportunity to experiment with new cooking methods and a variety of ingredients. (Boutelle et al, 2007).

Moreover, the consumption of commercial complementary food during infancy and childhood, especially ready-made milled vegetables/fruits, pasteurized flavoured milk, milk pudding, fruit juice etc., has been associated with increased sugar intake, while their homemade version had a negative effect in sugar intake (Foterek, Buyken, Bolzenius et al, 2016; Mattei et al 2012). A recent secondary analysis of feeding practices from a randomized trial of vitamin D supplementation in 132 healthy breastfed 1-month-old infants from Montréal, Canada, examined whether provision of homemade complementary food is associated with the development of dietary diversity, nutrient intake and quality of infant growth. The results of the study showed that provision of homemade complementary food is associated with increased dietary diversity during the first year of life and reduced adiposity (Mok et al., 2017). Furthermore, in many developing countries, commercial fortified food products are very expensive, thus, homemade complementary foods are the foods of choice during child feeding. The basic raw materials commonly used for the preparation of the complementary food are locally available staples, such as cereals, roots, and starchy fruits that consist mainly of carbohydrate and provide energy. Between populations there are many differences in choosing specific food item and the main

factors responsible for the choice of these food items are tradition, availability, and ease of access (Abeshu et al., 2016).

HFBs are often considered as luxury goods, since low cost of fast food and its nutrition value become a solution for many families who have neither time not money to cook at home. But HFBs also contribute to the economic well off of families. They are much more inexpensive than eating out or buying processed foods. Also, people that cook at home at a regular basis can save the leftovers and use them for their next meals. Another benefit of HFBs is that they may become important in strengthening the family bond. The transmission of cooking knowledge from one generation to another and the frequent consumption of family home-cooked meals have a tremendous impact on them.

Finally, obesity is an escalating public health problem that contributes to other serious health issues, including diabetes, high blood pressure and heart disease. The evidence shows people who cook at home eat a more healthy diet. Strategies are needed to encourage more cooking among the general population and help infrequent cookers better navigate the food environment outside the home. Time and financial constraints are important barriers to healthy cooking and frequent cooking may not be feasible for everyone. But people who cook infrequently may benefit from cooking classes, menu preparation coaching or even lessons in how to navigate the grocery store or read calorie counts on menus in restaurants.

1.2 **Dietary cultures, traditions and origins of fermented foods and beverages**

1.2.1 The importance of fermentation

Dietary habits are part of the cultural heritage of societies of different qualities, while at the same time it reveals important elements about the social and environmental influences they have received (Matala 2008). The process of fermentation along with the process of drying, smoking and adding salt is one of the oldest methods of food and beverage preservation and of improving their nutritional value. For this reason, it was an integral part of the history of traditional foods and beverages, while at the same time it was incorporated into traditional foods and beverages production techniques, as well as in the daily life of small-scale societies, such as provincial towns and villages. Fermentation, as a process of improving food and drink safety, has allowed our ancestors living in temperate and cool climates to survive in the winter, as well as those living in tropical areas to survive in drought periods (Marshall and Mejia, 2011).

Fermented foods and beverages are included to a greater or lesser extent in the main food items of the gourmet culture of all societies. (Tamang and Kailasapathy, 2010). Historical references to the consumption and practices of preparing traditional fermented foods and beverages are many and detailed in several parts of the world. However, the recorded sources are limited regarding their consumption, which is unknown in quite large areas and historical periods. Furthermore, for more ancient societies our knowledge is more fragmentary. The science of archeology is an important source of information, as materials that do not decay over time, such as vases, stone tools and stones, provide knowledge about the means and practices used in the preparation of fermented foods and beverages.

Fermentation of foods and beverages, at the level of know-how, has a past of at least 6,000 years, and is likely to be the result of natural and spontaneous microbial interactions. The first fermentation should have been carried out after the storage of surplus milk, which resulted in a fermentation product the next day. The earliest preparation of a lactic acid fermentation product is considered to be the production of sour milk (Steinkraus, 2002). In addition, Patrick E. McGovern and his associates (2004) confirmed in a study that the production of fermented beverages dates back more than 9,000 years. Based on the chemical analysis of an ancient organic material kept in ceramic vases in the Jiahu Neolithic village in northern China, it was revealed that a beverage consisting of rice, honey and fruits was produced around the same time period as beer and wine in the Middle East. Archaeological findings indicate that the know-how of the fermentation comes from the region of India and from pre-civilization settlements of the Indo River valley. It is believed that the knowledge of the fermentation process, which is

recorded in the four Vedas (Holy Hindu texts), came from the experiences, wisdom and prediction ability of the wise men, which were saved through oral tradition. (Farnworth, 2008).

Written instructions on the preparation of fermented foods and beverages, written in the Roman period, have been saved in Europe. Fermentation processes are believed to have developed over the years by women, with the aim of preserving food in times of lack of food, achieving desired flavors and flavors in food, and reducing toxicity (Rolle and Satin, 2002). During the Middle Ages, varieties of fermented foods and beverages depended on the availability of raw materials, environmental conditions, as well as on the taste preferences of local residents. Progressively, the belief that fermented foods and beverages were of particular nutritional and therapeutic value increased, thereby increasing their popularity and consumption (Farnworth, 2008).

Fermentation is described as the process of converting raw materials into a series of products with increased nutritional value. This conversion takes place through the metabolic action of microorganisms on a variety of substrates (Joshi and Pandey, 1999). Knowledge of microorganisms is therefore important for understanding the fermentation process, which began in 1680 when Antony Van Leeuwenhoek first presented and described the existence of micro-organisms using a microscope. Almost a century ago, Elie Metchnikoff claimed that health could be enhanced and ageing delayed by manipulating the gut microbiota with host-friendly bacteria present in yogurt. His theory re-emerged in the mid-1990 as a concept worthy of mainstream medical attention (Mackowiak, 2013). Louis Pasteur, in the mid-19th century, contributed decisively to the understanding of the fermentation phenomenon. Pasteur clarified the importance and role of microbes in the fermentation process and demonstrated that there are many different types of fermentations. Since the Pasteur era, knowledge in the field of microbiology, biochemistry, technology and mechanics of fermented foods and beverages has increased to a great extent (Tamang and Kailasapathy, 2010).

The skills of food preservation are provided by the indigenous people of many regions. The knowledge and skills of the process of fermenting raw material to foods and beverages at the local level were traditionally passed by older people who had the knowledge of traditional manufacturing practices to younger people. From antiquity to today, a variety of fermented foods and beverages have been prepared including milk, cereals, fruits, vegetables, fish, meats, and many other products. Knowledge of some of the above fermented products has been standardized and manufactured on a large commercial scale. However, for many other fermented products the information regarding the know-how is fragmentary and needs to be refined so that they can be marketed and their health benefits recognized by the general public. The most

important fermented products, important milestones in the history of food, are presented in **Table 3**.

Table 3. Important milestones in the history of fermented food and beverages **(**Farnworth, 2008)

Date	**Development/Location**
ca. 10.000 B.C. to Middle Ages	Evolution of the fermentation process from preserving the surplus, probably by pre-Aryans.
ca. 6000 B.C.	Wine production in the Near East.
ca. 5000 B.C.	Descriptions of health and nutritional value of fermented milk and beverages.
2000 π.X.-1200 A.D.	Different types of fermented milks from different regions.
500-1000 A.D.	Production of cereal-legume based fermented food
1907	Publication of the book ‘’Prolongation of Life’’ by Eli Metchnikoff on therapeutic benefits of fermented milks
1900-1930	Application of microbiology on production process of fermented products and the use of selected cultures of microorganisms.
1970-present	Development of products containing probiotic cultures or friendly intestinal bacteria

1.2.2 Diversity of fermented foods and beverages

Food safety is a primary need for human kind. With the passage of time, various food substrates have been introduced and modified along with gastronomic practices as a result of empirical practices. Various components that play a key role are climate change, topography, national preferences, social standards, regional economy, geopolitics, demography, nationality, religion, traditional beliefs and cultural characteristics (de Garine, 2001). Food and beverages, the diversity of their products and the innovations in their production have also been altered alongside the development of human culture.

Fermented foods and alcoholic beverages made from indigenous microorganisms or additional micro-organisms (starter cultures) is an important food category. Fermented foods and beverages

are consumed worldwide from many populations and each of them is considered specialized for their production and representative of their consumption. Campbell - Platt (1994) argued that about one-third of our diet consists of fermented foods, while Kwon (1994) estimated that about 20% of all foods consumed in the world belong to fermented foods. Data on the frequency of consumption of fermented foods are not widely available. A prediction is that 50-400 g fermented food and alcoholic beverages per inhabitant are consumed worldwide every day, accounting for about 5% -40% of the total daily food consumption.

The variety of fermented products, such as beverages (alcoholic and non-alcoholic), bread and other bakery products, meat, fish, vegetables, dairy products and fermented spices (FAO 1998, 1999, 2000a) are produced from the raw materials in many countries. A wide variety of cereals, fruits and vegetables are also used for the preparation of beverages or drinks that satisfy the thirst and the need for hydration (mostly non-alcoholic), as well as those, which are essentially alcoholic beverages and are consumed in special circumstances, e.g. celebrations. In some countries, consumption of distilled alcoholic beverages is preferred (Fellows and Hampton, 1992), while in some other countries the purchase and consumption of alcoholic beverages is directly influenced by the religious and cultural characteristics of each culture, for example the prohibition of alcohol consumption by Muslims (Marshall and Mejia, 2011).

There are about 5000 types of basic and secondary unrecorded fermented food and beverages worldwide, manufactured and consumed by millions of people belonging to different communities and ethnicities (Marshall and Mejia, 2011). Traditionally, women are actively involved in food production, with better know-how than men. For the traditional and standardized fermented dairy products, there are about 400 generic names (Robinson and Tamime, 2006). The diversity of beverages produced by the lactic fermentation process can be further increased by the use of milk from different animal species and / or breeds and the use of a wide variety of milk mixtures. More varieties can be obtained by adding sugar, fruits, spices, cereals and applying preservation methods, such as condensation, drying and freezing. Different methods of preparation and processing affect texture and taste, defining the use of the final product (as a main meal, snack, dessert, drink, etc.).

The diversity of fermented foods and beverages is directly related to each culture and the availability of raw materials. However, consumption of some less well-known traditional fermented foods is reduced due to changes in lifestyle and the transition from traditional foods to standardized foods and fast food. Climate change in some areas of the globe also has a tremendous effect on gastronomic practices. China, India (many different ethnic groups) and

Africa (various tribes) have the largest varieties of national fermented foods and beverages. Studies concerning the production and consumption of TFBs in each country, as well as the calculation of their per capita consumption, are important issues to be addressed by governmental food policy makers.

1.2.3 Beer and wine: Two alcoholic-fermented beverages with a decisive influence on western civilization

Alcoholic beverages represent a huge variety of products and include wine, beer and spirits (fermented and distilled). They have a special place in the diet as they are mainly consumed to accompany celebrations, cultural and religious events (Dugan, 2009). The production and consumption of fermented beverages attract interest, as they also have the advantage of increased nutritional value (Darby, 1979). Platt (1964) states that a traditional fermented beverage is an indicative example of "biological rejuvenation" due to the biological enhancement with essential nutrients through the fermentation process.

Fermented beverages have delineated the social relationships in the family, the members of a group of people and among the various social strata. Furthermore, they express the relationship between people and deities (Dietler, 2006). Despite the fact that there are several different types of alcoholic beverages, wine and beer are characterized as the most widespread and best known (**Table 4**).

Table 4. Some important alcoholic fermented beverages produced and consumed in different regions of the world. (FAO, 2011)

Fermented product	**Raw material**
Bear, ale	Barley
Rye beer	Rye
Corn beer	Corn
Potato beer	Potatoes and / or cereals
Grape Wine	Grape juice
Vinegar, cider	Apple juice
Pulque	Agave juice
Sake (sake sonti)	Rice
Mead	Honey

The consumption of wine is deeply rooted in the history of the Western world. The word "wine" comes from the Latin word "vinum", which means "fermented grape juice" and is made by the alcoholic fermentation of must (grape juice) or other fruit juice without the distillation process (Kiple and Ornelas, 2000). In spite of some controversies, reliable archaeological data place the grape harvesting at the end of the Chalcolithic and the Early Bronze Age in the region known as Levante, the eastern Mediterranean coastal region of Asia and the neighboring Inland areas (Johnson, 1989; Zohary and Hopf, 2000).

Every culture with increased wine consumption has its own legend regarding the origin of winemaking. However, since the grape fermentation is a spontaneous and natural process, the origin of the winery is virtually impossible to ascertain. Archaeological findings and chemical analyzes of wine residues found in the area of Hajji Firuz Tepe (Neolithic Age, 6th millennium BC) and the area of Godin Tepe (Early Bronze Age, 4th millennium BC) in western Iran, are considered by many scholars as the earliest testimony of winemaking (Renfrew, 2003; Wilson,

1999; Curtis, 2001). However, as the evidence is not strong enough, the above claim is treated with caution (Boulton and Heron, 2000).

In the early period of the Minoan and Mycenaean Bronze Age, the main evidence of wine consumption comes from the existence and use of specific pots and jars called "Amphorae" (Wilkins and Hill, 2006), as well as the finding of the remains of the press of the grapes (Zohary and Hopf, 2000). There is a small number of literary and archaeological findings about the know-how of wine production during the Classical period. However, there are many representations of vines, beverages and drunkenness (Curtis 2001, Wilkins 2006), mainly in ceramics, athenian jars and cups of the period between 540 and 430 BC. The viticulture probably spread to the Western Mediterranean by the Phoenicians, and certainly, the contribution of the Greeks was significant during the establishment of colonies along the Mediterranean coasts (Wilson, 1999; Curtis, 200). It was then widely spread in a large part of Europe from southern France and in due course by the Romans under the influence and spread of Roman culture (Wilson, 1999).

In Greece, wine consumption was a key element of Greek identity in the Classical era (Curtis, 2001). Unlike wine consumption in Egypt, the Middle East, Anatolia and early Bronze Age, wine was a basic food and not just a drink consumed exclusively by the upper class. Consumption was carried out as long as it was diluted with water and was a peculiarity to other cultures (Wilkins and Hill 2006). Wine was an important commercial commodity and therefore was an important part of the Greek economy, while a large percentage of Greek farmers was specialized in the cultivation of grapes (Curtis, 2001). They were also used in religious ceremonies, for medical purposes, and in men's gatherings for drinking called "banquets". The introduction of wine in Rome made this alcoholic fermented beverage as popular as in Greece. It was similarly used in all aspects of the everyday life of the inhabitants, focusing on the pleasure of its consumption and its use for medical and religious purposes (Curtis, 2001).

As far as vinification is concerned, the grapes intended for wine production were initially pressed into tanks. The pressure process was quite sophisticated, the pulp was pressed by mechanical press into a basket and the collected juices were for fermentation. During the fermentation, various ingredients, such as lime in the form of chalk and marble, was added to reduce acidity. Also, the creation of exceptional wine varieties required the addition of herbs or resins. Finally, some solid substances which were found in the fermented wine were removed and the final product was transferred to amphorae for acquiring age or for its transportation.

The second major beverage with a decisive influence on the western world is beer. Beer is a common, low-alcoholic fermented beverage in the world. Clay tablets depicting ancient beer production practices have been found in Mesopotamia and date back more than 5000 years. The exact date that the first beer was produced remains unknown. Also, the fermentation of beer was rather a spontaneous process (Hartman and Oppenheim, 1950). It is almost certain that it was not consumed before 10000 BC, but it appeared to have spread widely in the Near East until 4000 BC. Historically, the beer was originally prepared by the Sumerians before 7000 BC. (Dufour et al, 2003). A modern pictogram from Mesopotamia, an area corresponding to today's Iraq, represents two persons that consume beer from a large ceramic vase with the use of straws and is presented in **Figure 1** (Standage, 2005).

Figure 1. A pictogram found at Tepe Gawra in Mesopotamia depicting two figures consuming beer. It dates from approximately 4000 BCE. (Standage, 2005)

Although classical Greeks considered beer unsuitable for consumption, there is some evidence that beer consumption took place in remote areas of Greece, such as Northern Greece and Crete (Wilkins, 2006). Beer was also produced and consumed in some areas of the Italian peninsula from the early Roman ages. Despite the fact that wine was always popular among the Romans, the consumption of beer is explained by the fact that at the time of the Roman Empire its population included Europeans, Egyptians and Babylonians, in whom the consumption of beer was deeply rooted in their gastronomic culture.

Beer from the past was a beverage with a strong social, ritualistic and religious character. In ancient Rome, the habit of drinking beer was sometimes considered as a "barbaric act" and some other times was characterized as "purity" or "simplicity" of culture and detached from the sophisticated and yet corrupt center of the empire (Wilkins, 2006). The Sumerians and the

Egyptians used beer in their rites, in ceremonies in order to invite a good crop and in funerals. Possibly the religious use of beer has existed before its social use and is characteristic of every beer-producing culture (Standage, 2005).

Several researchers have expressed the view that beer has played a decisive role in the age of the agricultural revolution, during which hunting was replaced by agriculture. At that time, farmers used to drink beer, but this kind of beer did not have completed its fermentation process. In this way, they compensated for their reduced intakes of B vitamins (mainly for vitamin B12) due to reduced meat consumption. Also, stagnant water in small settlements has often been an easy and quick outbreak of infection. For this reason, the residents avoided the probably unsafe water sources and preferred streams of running water, which were usually away from their settlements. The indispensable condition of the boiling of the water for the production of beer has made beer the safest way of hydration compared to stagnant water (Standage, 2005).

During the Middle Ages and Renaissance in Europe, mainly in the Low Countries and England, beer became a typical beverage of urban populations with economic as well as social importance. Also it was regarded as a safe drink for daily consumption, less expensive than wine and a major source of tax revenue for the country. Sometimes it was used as medicine and consumed by men, women, and children alike. However, the transformation of the industry from small-scale production to a highly regulated commercial enterprise and the technological, economic, cultural, and political changes influenced the development of brewing during the centuries. In the nineteenth century scientific and industrial developments resulted in its todays form (Unger, 2004)

Data on ancient brewing practices in Mesopotamia are based on written sources and not on archaeological findings. A general summary is provided by Curtis (2001) and this interpretation claims that the early beer of Mesopotamia was prepared by the Sumerians using a raw material of barley malt, a grain that has been germinated and dried. Based on this interpretation the malt was initially crushed, mixed with aromatic elements, such as figs, honey and herbs, formed a dough with the addition of water and then baked. As a final product, a type of bread was probably formed that was called bappir or "beer brew''. The bappir was then mixed with green malt, peeled barley and water, and formed a liquid, the so-called "sikaru," which was then heated and stirred. The mixture was cooled and then subjected to fermentation (FAO, 2009). As soon as they were making the beer, they placed it in clay pots for transportation or storage (Samuel, 2000). Early beer contained residues, such as grains and grain corn, and for this reason it was consumed with a straw to avoid swallowing them (Standage, 2005).

Over time, various types of starchy plants have been used for brewing, including maize (in South America), soybean (in India and Iran), millet and sorghum (in Africa) and rice (in the Far East). However, nowadays barley is the most known raw material for beer production worldwide (FAO, 2009) and is the basis for industrial brewing. Some types of beer, such as those produced in the countries of Africa, and limbic beers produced in Belgium, are still traditionally prepared, in which mixtures of yeasts and bacteria are used to carry out the fermentations (Marshall and Mejia, 2011).

1.3 **History of production and consumption of NAFB**

1.3.1. Definition of NAFB

Homemade beverages are an important part of the cultural identity and everyday life of individuals from different ethnicities. These beverages may be distilled or fermented and may vary in alcoholic strength (The ICAP Blue Book, 2008). Typical example is wine, whose domestic production in the Mediterranean regions of France, Italy, Spain, Greece, Croatia and other countries, is a long tradition. Alcoholic beverages are widely available consumer goods and refer to beer, wine, alcoholic drinks and standardized beverage blends. Although both consumption rates and patterns vary from country to country, legislation and guidelines on alcohol sale and consumption are defined by the individual member states of the EU.

Based on EU Regulation 169/2011 on the provision of Food information to citizens and the European Parliament Resolution 2015/2543(RSP) an ‘’alcoholic beverage’’ contains an ‘alcoholic strength by volume’ (ABV, the number of liters of ethanol contained in 100 liters of a beverage, both volumes being measured at a temperature of 20^0C) of more than 1.2 %, whereas a ‘’low- alcoholic beverage’’ refers only to beverages, which have an ABV of 1.2% or less. Furthermore, for almost all the European countries, the limit of ABV for a ‘’non-alcoholic beverage’’ is considered 0.5%.

The EU Directive 7/250 / EEC governs the labeling of alcoholic beverages. According to this it is stated that the alcohol content (expressed as a percentage) should be indicated on the label of all beverages for immediate sale and if they contain alcohol at a concentration higher than 1.2%. A "low alcohol" is defined as a beverage with a content not exceeding 1.2% in alcohol. Also according to the BCAP Code, low-alcoholic beverages are those containing alcohol of between 0.5% and 1.2% (The BCAP Code, 2010). Taking into account the above data and for ease of reference, we make the assumption that non-alcoholic beverages and therefore NAFB are those beverages with a content not exceeding 1.2% in alcohol. It is also worth noting that the EU definition for alcoholic beverages content for tax purposes is at least 0.5% (for beer) or 1.2% alcohol concentration (for all other beverages). (Anderson and Baumberg, 2006). However, public policies need to draw up a common definition of non-alcoholic beverages, which will apply in all EU countries.

1.3.2. Dietetic rules and prohibitions, which may have influenced the production and consumption of NAFB among European populations

Each ethnicity has a different gastronomic culture in which food and beverages reflect both its cultural heritage and its socio-cultural aspects. Foods and drinks, made by different communities are unique. The factors influencing their production and consumption are geographical location, environmental factors, the availability of plant or animal sources, and the particular preferences, behavior and attitudes of individuals for their consumption.

Religions, dietary laws, common beliefs and social gatherings are some of the characteristics that contribute to the cultural identity of a nation (Tamang and Kailasapathy, 2010). Religions and dogmas greatly influence the formation of eating habits, mainly through dietary "laws", for example, taboos imposed on the consumption of certain foodstuffs. Some traditional products have been mentioned in holy books, such as the Bible and the Qur'an, and therefore the preparation and consumption of several of them has been influenced by religious traditions and taboo. Fermented foods and beverages are a large part of traditional products.

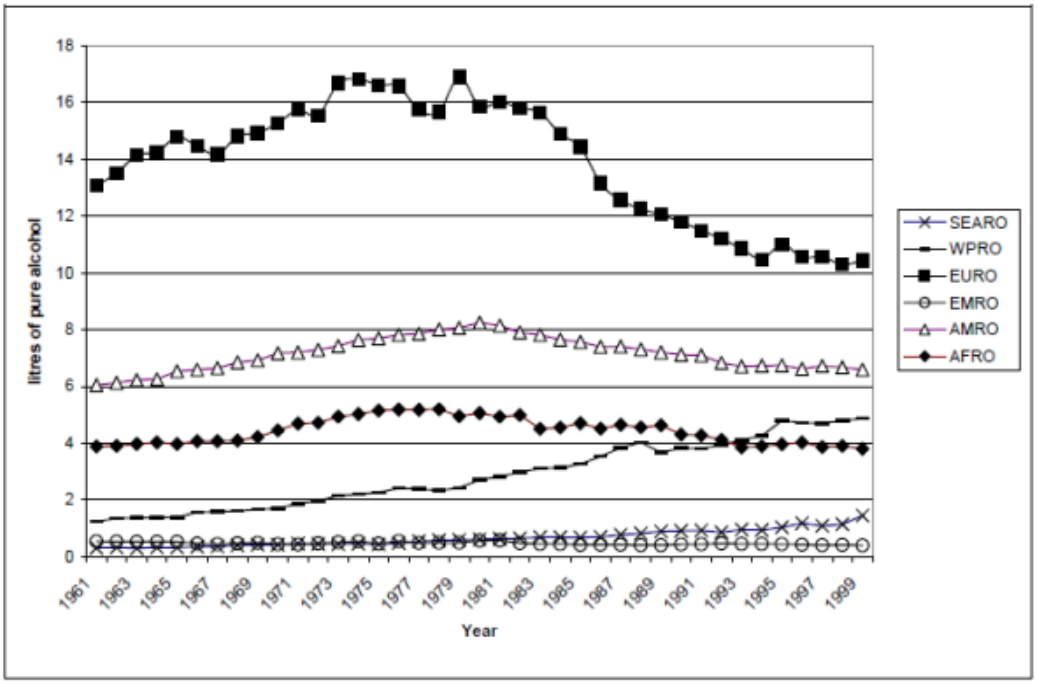
In European regions and more specifically in the southern Europe and the Mediterranean region, Christianity, Muslimism and less Judaism are up to now the most prevalent religions (Matala, 2008). According to statistical data of studies and despite the fact that Christianity is the predominant of the two dogmas, a growing Muslim population from all continents is recorded in Europe (Pew Research Center's Forum on Religion and Public Life, 2011). The largest Muslim populations are concentrated in Albania, Bosnia, Bulgaria, the former Yugoslav Republic of Macedonia and Turkey. The rapid increase in the number of Muslims in Europe began in the 1950s. In the West, where the Muslim population was previously very small, the increase was almost exclusively due to immigration, mainly from non-European countries. However, in the Balkans, the Muslim religion was promoted by the Ottoman Turks from the 16th century. For this reason, in the Balkan Peninsula, where older and well-established Muslim communities existed, the increase was due to the proportionate increase in birth rates.

With regard to dietary rules and prohibitions, in Christianity certain foods and beverages are used symbolically in the Divine Eucharist or society by Christians. The wafer for the Roman Catholic Church or the piece of bread for the Orthodox Church is placed on the tongue or hand, respectively, and represents the body of Jesus, while wine is drunk and symbolizes the blood of Christ (Hinnells, 1997). In fact, symbolic wine-making as a representation of Christ's blood was a significant distancing from the strong avoidance of blood consumption, which is forbidden by Jewish dietary laws.

As far as Islam is concerned, food consumption is governed by strict dietary rules for Muslims, which Mohammed defined. Prohibited foods for Muslims include avoiding pork, flesh of dead animals, blood in any form and any form of alcohol-containing beverage. According to the dietetic Muslim rules, food is prepared accordingly without the mixing of alcoholic beverages (Hussaini, 1993).

Focusing on alcohol consumption worldwide, alcohol consumption levels in the different regions appear to be fluctuating. The exception is the low consumption in the Eastern Mediterranean region due to the fact that the majority of the population is Muslim, as well as the Southeast Asian region (**Figure 2**). However, it should be noted that the alcohol consumption averages of the different regions might conceal large differences (WHO, 2004). The key term in this case is the "recorded" consumption of alcohol, as unrecorded alcohol consumption in Eastern Europe and Latin America is estimated at about one third of the recorded alcohol consumption. Calculating alcohol consumption in the above areas is difficult because a large amount of alcohol is smuggled or produced in the form of traditional homemade alcoholic beverages.

Figure 2. Weighted averages of recorded annual per capita alcohol consumption of adult populations in different regions of WHO Member States between 1961-1999. (WHO, 2004)



Note: All WHO member countries are classified in the following geographical areas:

AFRO – Africa Region

EMRO – East Mediterranean Region

EURO – Region of Europe

AMRO – Region of America

SEARO – South-East Asia Region

WPRO – Western Pacific Region

Recent evidence suggests that more than a quarter of all Muslims live as religious minorities in predominantly non-Muslim countries worldwide (Lapidus, 2002). Immigrants born in Muslim countries tend to follow Islamic rules. However, the Muslims of the Balkan Peninsula, which make up 20% of the total population, are considered to be the descendants of Orthodox and Roman Catholic Christians who have been Islamized for various reasons. The religious attachment of Muslims of the Balkan Peninsula could be characterized not strong at all. This is evident from frequent alcohol consumption, the habit of smoking, and European standard dress code. The liberal form of Islamism that dominates is considered the result of Ottoman tradition and long-lasting cohabitation with Christians. As a conclusion, we could assume that one of the factors that may influence the production and consumption of NAFB among European populations may be the avoidance of alcohol from some populations who live in Europe and with the same religious and cultural beliefs.

1.3.3 Fermented milks: A heritage of health and civilization

The First products must have been produced accidentally via natural fermentation of milk left-over**.** According to existing evidence, the souring of milk was used to produce butter, and probably milk was also consumed in a soured form. Many of the fermented milk-products being consumed nowadays, were originally developed by nomadic Asian cattle breeders. Climatic and environmental conditions in different parts of the world resulted in the domination of specific strains of microorganisms in these products and the evolution of specific types of fermentations. Nearly every civilization has developed fermented milk products of some type; however, those who first produced these foods were not aware of the presence of bacteria. Fermented milk-products are originating from different countries. Some typical lactic fermentation products and their origin are listed in **Table 5**. Approximately 400 generic names are applied to traditional and

industrialized milk fermented products (Robinson and Tamine, 2006), although practically the list of actual different varieties is much shorter (Tamang and Samuel 2010).

Table 5. Geographical origin of some important fermented milk products according to the indications worldwide (Farnworth, 2008)

Product	**Geographical origin**	**Type of the product**
Dahi	India	Coagulated sour milk
Chhash (buttermilk)	India	Diluted dahi ή the buttermilk left after churning of dahi in order to produce butter
Laban zeer/Khad	Egupt	Sour milk
Leben	Iraq	Traditional fermented milk
Cultured cream	Mesopotamia	Naturally soured cream
Kishk	Egypt and Arab emirates	Fermented milk-wheat mixture stored in the form of dried balls
Churpi	Nepal	Solid curd from fermented milk
Trahana	Greece	Very sour fermented milk and crushed wheat
Zabady	Egypt and Sudan	Natural type of yogurt

Milk can be fermented into a variety of hundreds of different products. Spontaneous fermentation occurs by developing many types of lactic acid bacteria (LAB) species in milk (Tamime AY, Skriver A, Nilson LE,2006). The growth of LAB promotes acidification, which inhibits spoiling microorganisms and pathogens. Many artisanal fermented milk beverages are produced via back-slopping, a method of fermentation which uses a small portion of already-fermented milk in order to begin a new fermentation. Cultures from the LAB naturally present in the raw milk are passed from household to household and between generations. In modern industry, spontaneous fermentations have been replaced by the addition of well-characterized bacterial strains (starters), which bring about fermentations in a more reliable way. Besides starters, other microorganisms (adjunct cultures) can be added to milk for the purpose of enhancing their organoleptic characteristics.

Fermented milks appear to have a special role in the diet of the populations of Greece, Turkey and Cyprus (Robinson and Tamine, 2006; Mayo et al., 2010). Their importance as foodstuffs is attributed firstly to their ability of preservation of all the nutrients of milk under ambient conditions and modifies others, enhancing its nutritional value. Also, they contribute to safe hydration (Standage, 2005). Their enhanced digestibility and the alleviation of lactose intolerance is attributed to the fact that they contain small amounts of lactose compared with milk and thus relieve symptoms of lactose-intolerance in consumers. The proposed health effects of fermented milks, include several benefits, such as the alleviation of lactose intolerance and the treatment of gastrointestinal disorders (lactic acid bacteria in fermented foods can decrease the incidence, duration, and severity of some gastric and intestinal illnesses, such as diarrhea (Mayo et al., 2010).

Among the many health effects of fermented milks, the alleviation of lactose intolerance is the best understood. Lactose intolerance is a condition where lactose (milk's sugar) is not completely digested due to the lack of the lactase enzyme required to break down lactose. Before animal domestication, all human populations were lactose-intolerant and milk was considered a toxin to adults because — unlike children — they could not produce lactase (Curry, 2013). As farming started to replace hunting and harvesting, cattle herders empirically achieved to reduce lactose in dairy products to tolerable levels by fermenting milk to make cheese or yogurt. Eventually, a genetic mutation spread through Europe and gave people the ability to produce lactase — and drink milk — throughout their lives. That biological adaptation contributed to the sustainability of communities in those instances, when harvests failed.

The ‘’milk revolution’’ is an example of an interaction between biology and culture. It is believed as a prime factor in spreading farmers and herders into northern Europe (Curry, 2013). Thus, in Scandinavia and Northwestern Europe, where people consume more milk, the prevalence of lactose intolerance is between 3% and 8%, while in Mediterranean regions, lactose intolerance remained the prevalent phenotype (ca 70%). Fermented milks contain reduced amounts of lactose and thus may assist in alleviating the symptoms of lactose malabsorption (Shah et al., 1992; Shah, 1993). For example, yoghurt-like fermented milks may delay gastric emptying and have a positive effect in relieving lactose intolerant symptoms (Shah, 1994). It has been reported that *kefir* (**Figure 3**) alleviates the symptoms of lactose intolerance, since it can provide an extra source of the enzyme (Hertzler and Clancy, 2003).

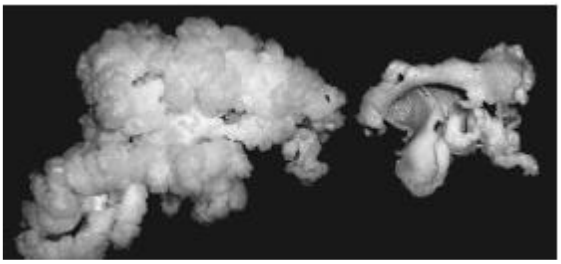


Figure 3. Two different types of kefir grains: yellowish, cauliflower-like grain (left) and whitish, foil-like grain (right) (Mayo et al., 2010).

Taking into account the microbiota dominating the fermentation, two fundamentally different fermented milk classes can be proposed (Tamime AY, Skriver A, Nilson LE (2006). The first one refers to the lactic acid fermentations, in which LAB species are the dominant group of microorganisms. Examples of fermented milks within this group are sour milk, buttermilk, laban and ayran and constitute by far the largest number worldwide. The second class refers to alcoholic and lactic acid fermentations, where LAB and yeasts species cooperate to generate the final product. Examples of fermented milks within this group are kefir and koumiss. In recent years, the beverage industry influenced by consumer trends has focus on the revival and re-introduction of these indigenous beverages into small and large scale producers (Galen, 2003). In addition, probiotic cultures, which are involved in the fermentation process, have beneficial effects especially on the normalization of intestinal microflora and enhancement of the immune responses (Marsh et al., 2014).

The high-value nutritional composition of milk has contributed to its consumption from the early stages of the establishment of human societies. Archaeological findings argue that its consumption was probably identified with the domestication of the animals (about 10,000-

15,000 years ago), and mainly by the cultures of Sumerians, Babylonians, Egyptians and Indians. Rocks discovered in the Libyan dessert and believed to date back to around 9000 BC depict the cow's worship and milking (Pederson, 1971). The real role of milk and dairy products in human nutrition varies greatly in the various regions of the world. (Tamang and Kailasapathy, 2010). There are several reports referring to the importance of milk and cheese in the formation of gastronomic culture in Greece (1500 BC) and Rome (750 BC) (Scott, 1986). Also traditional milk consumption is not mentioned in tropical countries, while in the northern regions, in North Europe (mainly in Scandinavia) and North America, milk and dairy products are consumed in larger quantities.

Cow milk is widely available all over the world and is the basis for most lactic acid fermentation products. Its rich nutritional value, coupled with the few antimicrobial substances it contains, makes milk an excellent medium for the growth of many microbes, including pathogenic microorganisms that cause food lesions. Therefore, milk is considered a particularly sensitive food, which cannot be stored for a long time without being spoiled. Emphasizing the nutritional value of milk over time has prompted man to invent processes that cause safe natural changes in milk. The aim of these procedures was to preserve its nutritional components, its sensible organoleptic properties and consumer preference (Tamime AY, Skriver A, Nilson LE, 2006).

Consumption of fermented milks containing bacterial cultures has been previously associated with beneficial effects on health. In 76 BC, the Roman historian Pliny proposed the consumption of fermented dairy products for the treatment of gastrointestinal infections (Bottazzi, 1983). But the initial observation of the positive effect of certain bacteria on health may have to be charged to the Russian scientist Metchnikoff. The work of Metchnikoff regarded as precursor of the discovery of probiotics (Fuller, 1992), as in 1907 he suggested that consumption of foods, such as yoghurt, kefir and sour milk, containing LAB, towards the promotion of health and longevity. Also in his book ‘’The prolongation of life " reported that Bulgarian peasants who ate large amounts of Bulgarian oxygala lived longer (Metchnikoff, 1907).

With regard to the Bulgarian oxygala, it contains bacillus *Bulgarican* (later renamed as *Lactobacillus bulgaricus*), which according to Metchnikoff reduce harmful bacteria in the gastrointestinal tract (Fooks et al. 1999). Also in the early 20th century Tissier, alongside Metchnikoff, postulated that bifidobacteria may be effective in preventing infection in infants, as were most prevalent microorganisms of the intestinal microbiota of breastfed infants (Ishibashi and Shimamura, 1993). Henneberg (1926) proposed the use of *Lactobacillus acidophilus*, which was isolated from the human intestine and is responsible for the production of so-called

«acidophilus-Milch," or "reformer yogurt" (Heller, 2001). This idea was very popular in the 1980s in Germany and other Western European countries, while strains of the genus *Lactobacillus* used to prepare the above fermented product (referred to as "mild yoghurt") were selected based on their technological properties and not because of their potential positive effects on health (Helle, 2001). Nowadays, probiotic foods consist an important part of the food market (Stanton et al., 2001), while their production continues and grows exponentially.

1.4 **The importance of NAFB in sustainable diets and health**

1.4.1 Value of NAFB as means of preservation and sustainability

One of the most important goals of fermentation is to extend the shelf life of food and beverages and for this reason it includes issues such as suitability, acceptability, and quality. Fermented products contribute significantly to food safety and the structure of food pyramids in many African, Asian and Latin American countries. Accordingly, small-scale fermentation technologies contribute substantially to food safety and enrichment of nutrition, particularly in cases of food shortages (FAO, 1998). A typical example is Sudan, during the famine between 1983-85, where the inhabitants survived by factoring and consuming specific traditional fermented products. With the above procedure, the prepared products had been safely preserved for several years. Their preservation has been accomplished both by the double action of the fermentation process, which produces acids with antimicrobial action, as well as by sun drying.

Fermentation is an inexpensive and energy-efficient tool for the maintenance of consumable raw materials. It is a feasible process even in marginalized, remote rural, urban and economically deprived urban areas. For example, milk is considered to be a highly susceptible food because it cannot be stored for a long time after its collection without being altered or processed. The phenomenon of spoilage is more pronounced in humid tropical regions, where the prevailing environmental conditions accelerate the decomposition process. There are various options for preserving fresh milk, such as cooling, dehydration, condensation and heat treatment. Especially for the preparation and preservation of fermented milk, however, little sophisticated equipment is required. Therefore, traditional fermentation is still an alternative way of preserving food and beverages (Marshall and Mejia, 2011).

Traditional knowledge of the production of fermented beverages has been acquired over the years, while traditional fermentation techniques have enhanced cultural viability and contribute to cultural value and social well-being in many regions of the world. In this way, beverages

were produced that constitute an integral part of many different cultures. Fermented beverages have contributed to the promotion and maintenance of culture, while primitive distillates from various fermentation processes have been produced in Asia since 800 BC. In addition to the extension of the safe period of consumption, the fermentation can also improve organoleptic characteristics, such as taste and appearance (FAO, 1998). The process of fermentation usually imparts a stronger taste to the beverages consumed by an ethnic group, thereby differentiating its gastronomic culture (Marshall and Mejia, 2011).

The process of fermentation was discovered by man at the beginning of the Neolithic period. Recent research suggests that fermented beverages compared to bread may have played a more decisive role in the transition of our ancient ancestors from hunter-collectors to farmers. Water and NAFB are considered refreshing. But the latter are more advantageous, as many contain nutrients, special flavors and aromas. In ancient Egypt, Mesopotamia, China, Rome and Greece, doctors used fermented beverages not only to relieve pain but also to treat a variety of diseases. It has been reported that ancient wonders, such as Egyptian pyramids, Royal Inca towns and huge irrigation networks, were built with workers who were rewarded with fermented beverages. This finding implies that these drinks also functioned as an exchangeable product (Bachelor, 2010).

NAFB are of considerable cultural significance. Examples are Skhou in the Caucasus from kefir (mare milk) and Arika from the Tartars (a Turkish ethnic group in Eastern Europe and North Asia) from koumiss (mare milk). Despite the multitude of nutritional benefits of NAFB compared to western-type processed and ready-to-drink commercial beverages, many fermented beverages are often associated with the drink's stigma of the poor. The possibility of buying beverages from the market, which discourages the consumer from making homemade fermented beverages, may be an explanation (Holzapfel, 2002).

Based on traditional perceptions of many communities around the world, there are perceptions that some NAFB have healing properties. It was believed that the bacteria contained in the above fermented beverages are beneficial and help food digestion, contribute to better nutrition and increase the effectiveness of the immune system. Furthermore, it was assumed that fermentation increases the acidity of beverages, inhibits their spoilage and eliminates pathogenic bacteria (FAO, 1998). A typical example is kefir, for which traditional perceptions of therapeutic benefits in Eastern and Middle Eastern Europe have a long history, focusing on its therapeutic effect on food-borne infections (Leroy and de Vuyst, 2004). The Russian scientist Metchnikoff (1907)

also expressed the view that the consumption of kefir, acidophilus milk and yogurt containing lactic acid bacteria (LAB) is related with achieving good health and longevity (Farnworth, 2008).

1.4.2. Biological importance of NAFB

NAFB have biological properties with significant consumer health benefits, mainly attributed to the micro-organisms they contain (Liong, 2008). LAB species are a significant part of the natural microbiota of the complex ecosystem of the gastrointestinal tract (Holzapfel et al., 1997; Holzapfel et al., 1998). Some strains of LAB, particularly species of the genera *Lactobacillus* and *Enterococcus* and species of *Bifidobacterium*, are used as additives probiotics and as therapeutic agents for the treatment of diarrhea, the stimulation of the immune system, the relief of symptoms of lactose intolerance and the reduction of serum cholesterol levels. It has been reported that consumption of probiotic yoghurt activates cytokine production in blood cells and enhances the activities of macrophages (Solis and Lemonnier, 1996). Also the probiotic strain of *Lb. acidophilus* La - 5 produces conjugated linoleic acid (CLA), which is considered an anticancer agent (Macouzet et al 2009).

NAFB are characterized for their improved organoleptic properties and are considered delicious and distinguishable for their particular flavors, their characteristic aromas and textures (Holzapfel, 2002). Typical examples are milk, whose sour taste is naturally produced, and fruit juices, whose characteristic flavor of alcoholic fermentation is produced very quickly. Lactic acid fermentations provide the consumer with a wide variety of organoleptic characteristics, conferring diversity on human nutrition (Steinkraus, 2002). With regard to fermented milk, LAB produce diacetyl, a by-product of fermentation which gives the fermented milk a characteristic flavor. (Kosikowski, 1977).

With regard to the nutritional value of NAFB, most of them contain enough water, contributing decisively to the prevention of dehydration. Also, a wide range of the above beverages can be prepared from pulp fruit or fruit juice. Many NAFB are consumed without the addition of other ingredients, while others are diluted with sugar syrup. This significantly increases the energy content of the diet. Some of these beverages also contain several vitamins and minerals (Steinkraus, 2002).

The biological enrichment of substrates of NAFB is carried out by the fermentation process in various ways. Some of these are the spontaneous increase in protein content, the improvement of the balance of essential amino acids, the increase in the vitamin content or bioavailability, and

the increase in the content of various bioactive compounds. For example, the pulque produced by the lactic fermentation of cactus juice (plant) is rich in vitamins, such as thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, and is an important fermented beverage for the nutrition of of low-income children in Mexico (Steinkraus, 1996). Biological enrichment through the fermentation process is of particular importance for developing countries. As the western world can economically cope with the industrial enrichment of food and beverages with specific nutrients, developing countries rely solely on organic enrichment for the intake of sufficient amounts of vitamins and essential amino acids (Steinkraus, 2002).

Biological preservation and antimicrobial properties are another characteristic of NAFB. Fermentation is one of the oldest food preservation techniques and ensures an extended storage life. It also improves microbiological food safety through alcoholic and lactic acid fermentation without interfering with the cooling process. In particular, the growth of LAB produced during the lactic acid fermentation results in a rapid reduction of pH by the production of organic acids, thus inhibiting the growth of pathogenic microorganisms. In this way, LAB can act as preservatives of biological origin (Holzapfel et al., 1995). Furthermore, the protective properties of LAB due to their antimicrobial action are useful at the stage of fermenting beverage, contributing to food safety. Consumption of LAB in fermented beverages, without reports of adverse health effects, provides a Generally Accepted As Safe (GRAS) situation. Also the bacteriocines they contain can function as bio-preservatives (Adams, 1999).

Finally, with regard to lactose metabolism, a large proportion of people suffer from lactose intolerance or lactose malabsorption. In this case lactose, the main carbohydrate of milk, is not completely converted into glucose and galactose (Onwulata et al., 1989). Since lactose is broken down into monosaccharides, lactose malabsorption results from a deficiency of β-D-galactosidase (Shah and Jelen, 1991). Kefir consumption minimizes the symptoms of lactose intolerance, providing an additional source of β-D-galactosidase (Hertzler and Clancy, 2003). It has also been observed that consumption of yoghurt can help alleviate the symptoms of lactose malabsorption (Shah, 1993). Generally, yoghurt and yoghurt with added probiotic is tolerated by people having lactose intolerance and may be due to partial hydrolysis of lactose from LAB during fermentation. Another explanation is that the yogurt as foods with thickened texture generally, delay gastric emptying and is effective in alleviating the symptoms of lactose intolerance (Shah, 1994). According to the above and oxygala acidophilus (whole or skim cow milk, which is inoculated with *Lactobacillus acidophilus* culture) may be better tolerated than oxygala acidophilus with sweet taste. An explanation may be given to the thick texture of

acidophilus, which increases the transit time of the intestinal tract compared to non-fermented milk (Shah, 2005).

CHAPTER 2: LITERATURE GAPS, PURPOSE OF THE RESEARCH AND METHODOLOGY

2.1 Literature gaps

Fermented beverages hold a long tradition and contribute to the nutrition and well-being of many populations worldwide. Admittedly, because of their importance in sustainable nutrition, security and health, they constitute a milestone in the history of humanity. Both alcoholic and non-alcoholic fermented beverages stand as typical traditional products. In regards to the former, such as the various types of beers and wines which are made with alcohol-producing yeasts, our knowledge on their diversity, uses and impact on health is at a satisfactory level. In contrast, the available literature on NAFB is very limited, lacking in information on several relevant issues, ranging from the terminology used to name these products to the methods applied in their production.

Previous research has examined NAFB from different scientific perspectives, namely food science, microbiology, ethnography and health. A body of knowledge has thus been compiled, albeit an attempt to integrate the existing data was never made, and, as a result, the information remains fragmentary and hard to interpret. For instance, the alleged health-promoting properties of NAFB are limited to a few products and are often based on anecdotal reports, rather than on research-based evidence. NAFB came to light a century ago when the nobel winner Elie Metchnikoff advocated the daily consumption of yogurt as a means for improving longevity. Since then, other scientists examined the properties of yogurt and other fermented milks. Relevant available evidence is derived from experimental and observational studies almost exclusively on fermented milks. Therefore, the existing evidence on the health effects of NAFB as a group of beverages is limited. Besides health benefits, some of the existing evidence addresses the potential health risks of NAFB, an issue that deserves further investigation. The available data on the nature and the properties of the starter cultures (eg. probiotic effect), metabolites and breakdown products of fermentation is also an area which awaits integration with other relevant data. Thus, in order to produce meaningful conclusions about the place of NAFB in human nutrition and their health implications, to begin with, an interdisciplinary approach is required.

A growing interest in the preparation and consumption of homemade foods and beverages is currently being observed among urban populations, including a recent trend in homemade NAFB. The motives and attitudes of home-fermenters, i.e. people who engage in fermentation at home-scale, have not been studied extensively.

Same as in the past, production of NAFB is predominantly done at home and therefore, the relevant knowledge is transferred informally, via interpersonal communication, and recently, via social media, as well. Traditional know-how practices continue to survive, diffuse and evolve over time. This dynamic knowledge which, is manifested in several forms, has received little attention so far.

In conclusion, NAFB deserve specific attention as they are not comparable to any other type of liquid food. They hold a unique place in the diet combining the attributes of health-promotion, sustainability and tradition. Despite this evidence, they are not as yet been considered as a distinct group.

2.2 Purpose of the study

On the basis of the literature gaps mentioned above, the aim of the thesis was to:

a. Add to the understanding on the role that NAFB hold in the nutrition of European citizens. In this respect, we aimed at examining the diversity of the products consumed and the factors which are responsible for this diversity (raw materials, microbiota involved, fermentation practices, cultural factors).
b. Contribute to the ongoing research related to the nutritional and health benefits of NAFB, through a synthesis of the available evidence.
c. Document and evaluate the attitudes, beliefs and concerns of modern citizens who undertake the production of NAFB at home.

2.3 Methodology

The present research consists of three studies, which, though, distinct, are interrelated.

Study I, collated and critically evaluated the information and scientific evidence concerning the cultural, biotechnological and health-related properties of NAFB. For this reason, an exploration was conducted across diverse scientific disciplines, such as dairy science, food chemistry and microbiology, medicine, consumer science, ethnology, food anthropology, biology, etc. In this way, data on the dietary role, nutrient composition, food culture, health benefits and other relevant aspects of different traditional NAFB consumed by European citizens were recovered.

Since a significant number of people with the same concerns search the Web in order to obtain or exchange information on a topic of their interest, Internet can serve as a mean of investigating and documenting perspectives and consumers' attitudes towards homemade foods, such as homemade NAFB. Thus, an in-depth examination of information on the Web about this topic was scheduled. Study II was a content analysis in which an extensive first and second generation sampling methodology and a detailed coding manual was applied in order to produce a valid depiction of what visitors to homemade NAFB webpages may encounter in digital space. Then, a valid and representative sample of 20 websites, blogs and forums (study sample) was obtained and their variables and features with regard to different types of homemade NAFB, preparation methods, cultural aspects, ways of promotion, and messages regarding their health effects, were recorded and evaluated during a time-period of six months. The on-line visitors' comments were also recovered and categorized within this time-period. The variables and features of the websites, blogs and forums, as well as, the visitors' on-line comments were categorized based on specific characteristics and their frequency of occurrence. The variables were pilot tested on a random sample of 10 sites in order to streamline the number of variables considered and most of them were objective and easy to code. The statistical analysis was straightforward and primarily descriptive and all the variables were categorical. Quantitative research methods (frequencies) were used in order to present the profile of the study sample.

In Study III, data from 2.349 on-line comments (wall comments and discussion topic comments) posted within a time-period of 12 months in 20 websites, blogs and forums with special interest in homemade NAFB was analyzed and evaluated. Using a content analysis model, the available information of the visitors' on-line comments were processed and evaluated and the theme categories of the on-line comments and main concerns and motivations of people interested in NAFB were comprehensively presented. A qualitative research design was used. Descriptive codes of the on-line comments were developed and were applied to the data. A qualitative

approach was chosen because it provides information about the characteristics of a particular group, in this case European citizens interested in the preparation and consumption of homemade NAFB, and their knowledge, perceptions, and attitudes towards this particular type of beverages. For the conduction of the analysis codes SPSS 13.0 software for Windows (SPSS Inc, Chicago, IL, US) was used. The statistical analysis was both quantitative and qualitative and all the variables were categorical. Regarding on-line comments, frequencies and relative frequencies were calculated and provided information on the comment content and the frequency of the post of the comment by the user.

CHAPTER 3: STYDY I

Traditional Non- Alcoholic Fermented Beverages Consumed in European Countries: A Neglected Food Group

3.1 Introduction

Ten thousand years ago, after the onset of agriculture, man's dietary adaptation to a few plant and animal species gave rise to new techniques in order to enhance the nutrient composition and, often simultaneously, rid their foodstuffs of their antinutritional effects (Farnworth 2008; Marshall and Mejia 2011). At the same time, settlement forced humans to collect foods as a store of supplies to secure food availability during periods of bad weather, when fresh food and safe drinking water were not readily available (Standage 2005). Especially for alcoholic beverages, such as beer and wine, data from recent research support their contribution to the transition of our ancestors from hunter-gatherers to farmers (Standage 2005; Farnworth 2008; Tamang and Samuel 2010; Marshall and Mejia 2011). Based on archaeological and archaeobotanical findings, it is generally believed that over 9,000 years ago people of the globe were already fermenting beverages (McGovern, Zhang et al. 2004). For instance, remnants in jars and vessels suggest that winemaking was popular in Neolithic Egypt and Middle East (Leroy and De Vuyst 2004; Farnworth 2008; Marshall and Mejia 2011). Overall, food fermentation stands as a remarkable benchmark in the history of human societies.

Historically, besides their role in human nourishment, fermented beverages have found other uses as well. They have been used as exchangeable products for laborers who worked in the construction of pyramids in Egypt and in royal cities and irrigation networks in ancient Central American cultures (Farnworth 2008; Marshall and Mejia 2011). Furthermore, many ancient cultures have used alcoholic fermented drinks as medicines; in ancient Egypt, Rome, and Greece as well as, in ancient Mesopotamia and China, fermented beverages were used to relieve pain and to prevent or treat diseases (Marshall E 2011). *Koumiss*, a traditional alcoholic fermented beverage of Kazakh nomads made from mare's milk had been used by Russian doctors for the treatment of tuberculosis and diarrhea [(9)]. *Sorghum beer*, a good niacin source, has helped to prevent pellagra in Southern Africa (Farnworth 2008; Marshall and Mejia 2011). It has also been observed that children who consumed the dregs of sorghum beer were protected against the development of pellagra (FAO 1998). In the United Republic of Tanzania, it has been observed that children who consumed fermented gruels showed a decrease in the number of reports for diarrhea by one third as opposed to those who were fed with unfermented gruels; this difference

was attributed to the inhibitory effect of the microbiota of fermentation towards pathogenic bacteria (Farnworth 2008; Marshall and Mejia 2011).

Fermentation contributes to food security, especially in agro-pastoralist societies. As an example, in Indonesia, the wastes of groundnut press cake and tapioca are often fermented to produce nutritious foods, namely *tempte-bongrek* and *ontjom*, foods that are important in the daily regimen of the poorest people(FAO 1998), while koumiss had been used as a safe and easy to transport beverage for nomadic populations of Central Asia, who had to travel very often to places with variations in climatic and environmental conditions (Tamang 2010). The *Kawal*, a fermented product made of the leaves of a wild African legume, is believed to have helped children and adults in Sudan endure the 1983-85 famine (FAO 1998).

Fermentation enables the preservation of foods as well as the transformation of the raw material into a new product with unique sensorial properties (Holzapfel 2002; Rolle and Satin 2002; Steinkraus 2002; Tamang and Samuel 2010) and enhanced nutritional value. Food and beverages that are prepared via a fermentation process represent an important part of human nutrition in practically every food culture around the world (Tamang and Samuel 2010). Fermented/pickled fruits and vegetables are very popular in many regions of Europe, Asia, America and Africa and Middle East (Josephsen, Jespersen et al. 2004). Fermented fruits juices, tea leaves, and products in brine are widely consumed in Asia. Fermented cereals, roots and tubes, such as pickles, porridges and gruels make a major contribution to dietary staples in countries across Africa, Asia, Europe and Latin America (Josephsen, Jespersen et al. 2004), while fermented seeds and fish are also widespread in many regions around the globe (Josephsen, Jespersen et al. 2004). With regard to fermented foods in liquid form, in western societies, beverages made with alcohol-producing yeasts, such as beers and wines, are the dominant ones (De Garine and De Garine 2001; Standage 2005). Alcoholic drinks played an important role throughout most of western civilization's history as a source for hydration and energy; however in most recent history, they are responsible for many major health and social destructors. But fermentation need not always result in a beverage with alcoholic content. Non-alcoholic fermented beverages have been treasured as major dietary constituents in numerous European countries because of their keeping quality under ambient conditions and prolonged self-life, thereby contributing to food security and improving food safety (Sõukand, Pieroni et al. 2015). The use of terms ''alcoholic beverage'' and ''NAFB'' is subject to varying regulations in different European countries. According to EU Regulation 169/2011 on the provision of Food information to consumers and the European Parliament Resolution 2015/2543(RSP) an ''alcoholic beverage'' contains an 'alcoholic strength by volume' (ABV, the number of liters of ethanol contained in

100 liters of a beverage, both volumes being measured at a temperature of 20^0C) of more than 1.2 %, whereas a ‘’low- alcoholic beverage’’ refers only to beverages which have an ABV of 1.2% or less. For the majority of the European countries, the limit of ABV for a ‘’non-alcoholic beverage’’ is considered 0.5%.

The diversity of traditional fermented beverages in Asia and Africa has been well described in review articles and textbooks (Steinkraus 1995; Steinkraus 2002; McGovern, Zhang et al. 2004; Tamang and Samuel 2010; Sõukand, Pieroni et al. 2015). For example the rich legacy and diversity of traditional fermented foods and beverages of the Himalayas have recently been recorded by Tamang (Sõukand, Pieroni et al. 2015). However, the scientific literature contains limited information on NAFB prepared and consumed by European populations. Thus, the primary purpose of the present review is to provide an overview of the research regarding traditional NAFB in European cuisines, including a documentation of the different types and a record of their modern and traditional names. Second, this review aims at comprehensively presenting information on the raw material undergoing the fermentation, the microbiota involved, as well as, the health effects, dietary importance, and cultural aspects of the end-products. The results of this research are summarized in the tables, but selected traditional beverages are presented extensively. Finally, because in the last decades the food and beverage industry focuses on the revival and re-introduction of these indigenous beverages, their place in the European market and their perspectives and innovations are discussed.

3.2 Diversity of traditional non-alcoholic fermented beverages

Traditional NAFB constitute an integral part of food culture of many European countries. They represent socially accepted products for habitual as well as, ritual consumption. A diversity of traditional NAFB (Tamang 2010; Marshall and Mejia 2011) are produced from both edible and inedible raw materials in many European countries. Some of these beverages are well documented in the scientific literature, but for most of them, the existing information with regard to the names used (traditional and modern), the substrate and microbiota of fermentation involved, the spread of their consumption, the preparation method(s), the nutrient composition and perceptions on their nutritional value is incomplete. A wide range of substrates, including milk, cereals, fruits and vegetables, are used for the production of NAFB. These substrates provide the criteria for the integration of traditional NAFB into different categories. Representative examples of traditional NAFB are presented in each category of these beverages.

Traditional fermented non- alcoholic milk-based beverages

Kefir

Kefir or *Kefyr* (in Central Asia and Middle East) or *kephir/kiaphur/kefer/knapon/kepi/kippi* (in Balkan-Caucasian region) is one of the oldest milk-based fermented beverages (Robinson R K 2006; Tamang 2010; Tamang and Kailasapathy 2010; Tamang and Samuel 2010) (**Table 6**)**.** It can be made from any type of milk (goat, sheep, cow, camel, buffalo) and kefir grains (Tamang 2010; Tamang and Samuel 2010). Nowadays, novel varieties are also being made from milk substitutes, such as soy, rice and coconut milk (Tamang and Kailasapathy 2010; Kabak and Dobson 2011; Panesar 2011; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014). The word ''kefir'' originates from the Turkish word ''*keyif*'', which means ''good feeling'' and, is believed to describe the sense experienced when consumed (Lopitz-Otsoa, Rementeria et al. 2006; Altay, Karbancıoglu-Güler et al. 2013). It has been traditionally prepared by shepherds in the Caucasus mountains (Lopitz-Otsoa, Rementeria et al. 2006; Özdestan and Üren 2010; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014) in bags made from animal hides, oak barrels or earthenware pots (Robinson R K 2006). Kefir´s production and consumption originates from the countries of Eastern Europe, especially the Balkan-Caucasian region and Russia (Steinkraus 2002; Özdestan and Üren 2010; Tamang 2010; Tamang and Kailasapathy 2010; Chandan 2013; Marsh, Hill et al. 2014). It has been widely consumed in Soviet countries for centuries; however nowadays is increasingly popular in Japan, USA, Middle East and Africa (Tamang 2010).

The type and amount of milk and the complex interactions between yeast and LAB may influence the sensorial and textural properties of kefir (Altay, Karbancıoglu-Güler et al. 2013). Specifically, its flavour depends on the metabolism of LAB and yeast. Ethanol has little impact on flavour but may contribute to the aroma (Robinson R K 2006). Kefir is a self-carbonated (some effervescence caused by carbon dioxide), slightly foamy and viscous beverage, with a uniform creamy and elastic consistency and sour, acidic and slightly alcoholic flavor (Lopitz-Otsoa, Rementeria et al. 2006; Robinson R K 2006; Tamang and Samuel 2010; Panesar 2011; Altay, Karbancıoglu-Güler et al. 2013). It also has a perceptible yeast aroma and white or yellowish color (Tamang and Samuel 2010; Panesar 2011).

Kefir is regarded as an easily digested, effervescent fermented milk beverage and is esteemed for its nutritional value (Lopitz-Otsoa, Rementeria et al. 2006; Melo and Silva 2014; Wolfe and Dutton 2015). It typically contains (per 100g) 3.0–3.4 g. of protein, 1.5 g. of fat and 2.0–3.5 g. of lactose (after the fermentation stage). However, the lactic acid content may range between 0.6

and 1.0 mL per 100 mL of the final product (Robinson R K 2006). Kefir's vitamin and amino acid content increase during fermentation via biological enrichment (Kabak and Dobson 2011; Melo and Silva 2014). The fermenting action of kefir bacteria and yeasts increase the biological value of milk, increasing synthesis of B group vitamins. It has been proposed by many researchers that during kefir fermentation pyridoxine, vitamin B12, folic acid and biotin are produced by the microbiota (Kneifel and Mayer 1991; Liutkevičius and Šarkinas 2004), but it is depending on the type of milk and the microbiota composition (Ahmed, Wang et al. 2013). The incorporation of *Propionibacterium freudenreichii* strains in the kefir microbiota may enrich the product with vitamin B12 (Van Wyk, Witthuhn et al. 2011). Its alcoholic content is usually <2% (<0,3% w/v for Turkish kefir) (Özdestan and Üren 2010).

Typically, the raw material used for the production of kefir is cow milk, fortified with cheese whey (at homemade scale) (Paraskevopoulou, Athanasiadis et al. 2003) or ultrafiltered skimmed milk (at industrial scale)(Robinson R K 2006). Two methods have been described for kefir production, the traditional («authentic») and the industrial («commercial») (Lopitz-Otsoa, Rementeria et al. 2006; Chandan 2013). The type of fermentation observed in kefir is the result of a yeast-lactic fermentation. Traditionally, kefir grains are added to milk, left at room temperature for fermentation for 18-24h; the grains are then removed and can be used in a new fermentation cycle. The resulting fermented milk is thus ready for consumption (Lopitz-Otsoa, Rementeria et al. 2006). Commercial types of kefir may be blended with sugar and fruit juices or flavours (Tamang and Kailasapathy 2010).

Microbiota identification shows that kefir is a symbiotic combination of bacteria (~ 83-90% LAB and acetic acid bacteria), lactose fermenting and lactose negative yeasts (~10-17%), such as *Naumovozyma, Kluyveromyces, Kazachstania,* other bacterial groups and possibly moulds (*Geotrichum candidum*), bound within a polysaccharide matrix, known as kefir grains or kefiran, made of casein and complex sugars (Lopitz-Otsoa, Rementeria et al. 2006; Robinson R K 2006; Kabak and Dobson 2011; Panesar 2011; Wolfe and Dutton 2015). Kefir grains are filtered off after each use and reused for the inoculation of the next batch (Chandan 2013). Kefir milk possesses a lower diversity of bacteria compared to kefir grains. Only four phyla have been identified in kefir samples, Actinomycetes, Bacteroidetes, Firmicutes, Proteobacteria, with Bacteroidees traced only in kefir milks (Marsh, O'Sullivan et al. 2013). Bacteria involved in kefir's production belong to the genera *Lactococcus, Lactobacillus, Leuconostoc* and *Acetobacter* (Marsh, Hill et al. 2014). *Lactobacillus* is the dominant genus in the kefir grains while *Lactococcus* and *Leuconostoc* are prevalent in kefir milk. Pyrosequencing analysis of kefir samples has revealed that *Acetobacte*r genus is not always detected, indicating that it is not

required for the process of fermentation, contributing probably in other characteristics of the product. Bifidobacteriaceae were traced only in a minor number of kefir grains. High-throughput sequencing enable the detection of bacterial genera associated with the intestinal microbiota, rarely found in kefir samples and some of them (*Faecalibacterium, Allistipes*), identified for the first time in kefir (Marsh, O'Sullivan et al. 2013). Because many of the LAB in the kefir grains, such as *Lb. acidophillus, Lb. helveticus, Lb. casei, P. dextrinicus, P. acidilactici, P. pentosaceus* etc. (Altay, Karbancıoglu-Güler et al. 2013; Tamang, Watanabe et al. 2016), are known to have probiotic properties, kefir is also being regarded as a potentially probiotic product (Lopitz-Otsoa, Rementeria et al. 2006; Magalhães, Pereira et al. 2010; Özdestan and Üren 2010; Tamang and Kailasapathy 2010; Kabak and Dobson 2011; Melo and Silva 2014; Tamang, Shin et al. 2016). The microbial counts of traditional and commercial kefir are different. The carbohydrate, fat and protein content of the milk used can affect the microbiota profile (Altay, Karbancıoglu-Güler et al. 2013). The main metabolites of the kefir fermentation are lactic acid, produced by LAB and ethanol, carbon dioxide, produced mainly by the yeasts but also by heterofermentative LAB. Carbon dioxide content increases during fermentation as the pH drops. If the fermentation is carried out for longer than 24 h, carbon dioxide production plateaus after 48 h. The concentration of carbon dioxide in traditional kefir varies between 0.65 g/L (grain free, 24h)-1.33g/L (grain fermented, 24h) (Clementi, Gobbetti et al. 1989). Also, volatile acids, acetaldehyde, diacetyl and acetoin (flavour compounds) are found in smaller quantities, while biogenic amines have been traced in kefir samples but in very low amounts, below the allowable limits (Robinson R K 2006).

Ayran

Ayran is a dairy NAFB (**Table 6**). It is a salt-containing yoghurt drink made from cow milk or other types of milk (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013). Ayran is consumed in Turkey (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014) Bulgaria, Macedonia, Kazakhstan, Kyrgyzstan and Azerbaijan (Chandan 2013). Beverages that are similar to ayran include the *ayrani* (Cyprus), the *Jugurt/eyran* (Turkey), the *dhalle* (Albania), the *ayryan* (Bulgaria) and *the ariani* (Greece) (Chandan 2013). Ayran is a low viscosity drink, easily digestible and consumed mainly during summer months (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013). Its composition depends on the type of milk used, milk's fat content and the dilution rate used; for instance its protein content by weight may range between 1.5% and 3.5% (Altay, Karbancıoglu-Güler et al. 2013).

Ayran is traditionally prepared by blending yoghurt with water (30-50%) and salt (0,5-1%), is produced daily and consumed fresh (homemade version) (Altay, Karbancıoglu-Güler et al. 2013). It can also be produced industrially by the addition of *Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* to standardized milk (industrial version) (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013). The resulting microbial composition of homemade ayran is generally similar to that of yoghurt (Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014). Microbiota of fermentation consists of LAB bacteria such as *Lb. delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus,* with microbial populations varying due to several factors, such as the increase of the acidity (Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014). The population of yoghurt bacteria in industrially produced ayran is higher than in homemade ayran (Altay, Karbancıoglu-Güler et al. 2013). Some strains of *Lb. delbrueckii* subsp. *bulgaricus,* which are used as a starter culture, may produce bitter peptides (Altay, Karbancıoglu-Güler et al. 2013). Furthermore, lactic acid may be produced by the starter cultures, even during storage (post-acidification).

Buttermilk

Buttermilk (or *clabbered milk)* is usually made from cow milk and less often, from buffalo milk (Tamang 2010; Panesar 2011) (**Table 6**). Buttermilk's preparation has been always associated to butter production. For this reason, it is consumed in regions where butter-making is common (Robinson R K 2006), e.g. Russia, Bulgaria (*Urgutnik* made from sheep milk), Ireland (*Clabber* made from sheep milk), Southern Scandinavia (the Finnish *Kirnupiima* made from sheep milk) and Hungary (*Savanyutez* made from sheep milk), particularly during summer months (Robinson R K 2006; Young WP 2006; Tamang 2010). It is also consumed in the USA, Canada, Middle East, Egypt, Ethiopia, India, Australia and New Zealand (Tamang 2010). Natural buttermilk is different from the *Bulgarian buttermilk* or *acidophilus milk* (Leatherman and Wilster 1944). Nowadays, buttermilk has been mostly replaced by its modern version, the c*ultured buttermilk* (Robinson R K 2006; Tamang and Kailasapathy 2010). Buttermilk is a fluid of very low viscosity (due to the mechanical treatment, the churning of the cream) (Robinson R K 2006) and could be slightly yellowish in color (usually due to the addition of coloring agent during butter production). It has sour taste (Tamang 2010). Besides used as a beverage, buttermilk can be used in cooking as well, in the same way as sour cream.

Traditionally, buttermilk is produced right after milk or cream is churned (Leatherman and Wilster 1944; Tamang and Kailasapathy 2010), as a part of the butter-making process (Tamang

and Kailasapathy 2010), while the overall quality of buttermilk is entirely dependent on how the process of butter making is optimized (Robinson R K 2006). The microbiota involved in the fermentation process includes mesophilic LAB (Tamang 2010). The microorganisms present in the starter culture are similar to those used for the production of *surmjolk*, a traditional fermented milk consumed mainly in the Southern and Western parts of Nordic countries(Robinson R K 2006). The optimal temperature of buttermilk production is 17-22^{0}C, while this range of temperature reassures the growth of mesophilic LAB (Tamang and Kailasapathy 2010).

Traditional fermented non- alcoholic cereal-based beverages

Boza

Boza, a cereal-based fermented beverage, is a type of millet beer. In this respect, its origin can be traced back to 8.000-9.000 years ago, when cereals were first fermented by man to produce beverages (Arici and Daglioglu 2002) (**Table 7**). The word boza derives from the Persian word *buze* (Leatherman and Wilster 1944), which means millet. It is made from wheat or rice semolina or from a combination of rye, oat, barley and millet flour for best quality and taste (Arici and Daglioglu 2002; Marsh, Hill et al. 2014). Maize can also be one of the raw materials (Gotcheva, Pandiella et al. 2001; Blandino, Al-Aseeri et al. 2003; Yeğin and Üren 2008; Albuquerque, Costa et al. 2013; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014) mixed with sugar (Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Kabak and Dobson 2011; Sõukand, Pieroni et al. 2015). Boza is widely consumed in Turkey (Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Yeğin and Üren 2008; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014) and in other countries of the Balkan Peninsula, such as Bulgaria (Sofia, Varna, Burgas) (Gotcheva, Pandiella et al. 2001; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Todorov, Botes et al. 2008; Kabak and Dobson 2011; Albuquerque, Costa et al. 2013; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014), Albania (Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Kabak and Dobson 2011), Romania (Gotcheva, Pandiella et al. 2001; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Kabak and Dobson 2011), South Russia, Fyrom (Kabak and Dobson 2011), Anatolia, Middle East and Nothern Persia (Arici and Daglioglu 2002). *Braga* or *brascha* is a similar beverage consumed in East European countries, *Busa* is another similar beverage consumed in the Balkans (cocoa is included in the standard boza recipe), while *bouza* is also a similar beverage consumed in Egypt (Arici and Daglioglu 2002). It is produced both at artisanal and industrial scale (Yeğin and Üren 2008; Marsh, Hill et al. 2014). In several Balkan countries, boza may be consumed on a daily basis (Todorov, Botes et al. 2008), mainly in winter time (Kabak

and Dobson 2011). In Turkey, boza is considered to be beer's ancestor and is sometimes served with cinnamon and roasted chickpeas (Arici and Daglioglu 2002; Yeğin and Üren 2008).

Boza is a viscous beverage with a form of colloid suspension (Kabak and Dobson 2011), with slightly sour or sweet flavour (depending on its acid content) (Leatherman and Wilster 1944; Gotcheva, Pandiella et al. 2001; Todorov, Botes et al. 2008; Albuquerque, Costa et al. 2013) an acidic-alcoholic odor and pale yellow or from light to dark beige color (Arici and Daglioglu 2002; Altay, Karbancıoglu-Güler et al. 2013). Its odor and taste are affected by metabolites deriving via alcohol fermentation (Altay, Karbancıoglu-Güler et al. 2013). Boza's variations in composition and nutritive value are the result, first, of the utilization of different types and amounts of cereal products (raw materials) and second, of spontaneous fermentation conditions (Altay, Karbancıoglu-Güler et al. 2013). The selection of raw materials is very important, as these affect the degree of fermentability, viscosity and dry matter content (Altay, Karbancıoglu-Güler et al. 2013). Boza is a source of, protein, carbohydrate, fiber and vitamins, including thiamine, riboflavin, pyridoxine and niacin (Arici and Daglioglu 2002; Kabak and Dobson 2011). Boza's alcoholic content is either not detectable or up to 1.5 % (w/v) (Gotcheva, Pandiella et al. 2001; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Sõukand, Pieroni et al. 2015). Turkish boza, in particular, has an alcoholic content of 0.03%-0.39% (w/v) (Yeğin and Üren 2008) or lower than 2% by volume in both sour and sweet version, according to the Turkish Boza Standard, TS 9778 (Arici and Daglioglu 2002).

Boza's preparation involves six stages: preparation of raw materials, boiling, cooling, straining, addition of sugar and fermentation (Arici and Daglioglu 2002). Another option for its production is the use of previously fermented boza as inoculum. The types of fermentation observed are lactic acid fermentation by LAB and alcohol fermentation by yeasts. Microbiota identification of boza shows that it mainly consists of LAB (most of them lactobacilli, such as *Lb. plantarum, Lb. acidophilus, Lb. fermentum, Lb. coprophilus, Leuconostoc raffinolactis, Ln. mesenteroides and Ln. brevis*) and yeasts (such as *Saccharomyces cerevisiae, Candida tropicalis, C. glabrata, Geotrichum penicillatum and G. candidum*) (Leatherman and Wilster 1944; Gotcheva, Pandiella et al. 2001; Robinson R K 2006; Prado, Parada et al. 2008; Albuquerque, Costa et al. 2013). Generally, LAB dominate; in the Bulgarian boza especially, the average LAB/yeasts ratio amounts to 2.4(Blandino, Al-Aseeri et al. 2003). *Boza* is considered to be a rich source of probiotic bacteria, such as *Lb. plantarum, Lb. paracasei, Lb. rhamnosus and Lb. pentosus* (Altay, Karbancıoglu-Güler et al. 2013). Some of these bacteria are known to exhibit pronounced auto-aggregation properties as well as, antiviral and antibacterial activity (Todorov, Botes et al. 2008).

Kvass

Kvass is a cereal-based beverage, used mostly as a type of soft drink (National Centre for Biotechnology Education 2002; Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014) (**Table 7**). Traditionally, it is produced from rye and barley malt, rye flour and stale rye bread (Dlusskaya, Jänsch et al. 2008). Another version of Kvass, *Kvass southern*, is made from water, rye bread, sugar, yeast, juniper berries (*Juniperus communis L.*) and raisins (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013). *Mint Kvass*, a traditional Russian drink, is another version, which is made from stale dark rye bread(National Centre for Biotechnology Education 2002), to which water, sugar, dried yeast, fresh mint leaves and raisins or sultanas are added(National Centre for Biotechnology Education 2002). The mint can be omitted or replaced by honey or lemon peel. *Kvass* has normally a low alcoholic content, 1% or even less; if it exceeds this concentration, then is considered spoiled (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014). Kvass is a very popular beverage in the countries of the former Soviet Union, especially in Russia (National Centre for Biotechnology Education 2002; Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014; Sõukand, Pieroni et al. 2015). In the past, it was also consumed in parts of Eastern Poland (Arici and Daglioglu 2002; Todorov, Botes et al. 2008). In Esthonia, *kali*, a beverage similar to kvass, was produced in conjunction with beer, from the grain surplus after beer's production (Sõukand, Pieroni et al. 2015).

Kvass is a sparkling, sweet or sour beverage with a rye bread flavour and golden-brown color (National Centre for Biotechnology Education 2002; Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014; Sõukand, Pieroni et al. 2015), while Mint Kvass is slightly carbonated (National Centre for Biotechnology Education 2002). Mint Kvass is served chilled and it is popular in Russia ''fast food'' restaurants (National Centre for Biotechnology Education 2002). Kvass contains carbohydrates (mainly maltose, maltotriose, glucose and fructose), proteins and amino acids, lactic and acetic acid, ethanol, minerals and vitamins originating from the raw materials or from the microbial metabolic activity (Dlusskaya, Jänsch et al. 2008).

Two main kvass-making techniques exist, which use as raw material either stale sourdough bread or malt (Dlusskaya, Jänsch et al. 2008). In the first technique, the sugars needed for the yeast fermentation derive from the bread, while in the second, rye malt and rye flour (boiled with excess water) are the raw materials and gelatinized starch is cleaved by malt enzymes. In case the rye bread is not stale, it should be placed in the oven in order to be dried slowly (Dlusskaya, Jänsch et al. 2008; Albuquerque, Costa et al. 2013). Prior to the addition of starter and sugar, the kvass batter is diluted in boiling water and clarified by sedimentation. Kvass southern

preparation methods are baking and boiling (Albuquerque, Costa et al. 2013). The main stages of the preparation method of mint kvass are: preparation of raw materials, drying in an oven, boiling, cooling and straining, sugar addition and fermentation (National Centre for Biotechnology Education 2002). When made at home, a sourdough stock culture is used as a starter/inoculum for the fermentation. Kvass is produced in an industrialized scale, using starters and the final product is often pasteurized and supplemented with preservatives (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014; Sõukand, Pieroni et al. 2015). Kvass is very rich in microbiota consisting of viable yeasts and LAB (Dlusskaya, Jänsch et al. 2008). Its microbiota of fermentation consists of LAB (*Lb. casei, Ln. mesenteroides*) and yeasts (*Saccharomyces cerevisiae*), but the composition on a species level is variable, due to differences in fermentation techniques and feedstock (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014).

Traditional fermented non- alcoholic fruit-based beverages

Hardaliye

Hardaliye is a fruit-based NAFB (**Table 8**). It is made from red grape juice and crushed black mustard seeds, even though other ingredients, such as pomace and sour cherry leaves can also be used (Coskun and Arici 2006; Aydoğdu, Yıldrırm et al. 2014). Sometimes benzoic acid is added as a preservative (at industrial scale) (Arici and Coskun 2001; Kabak and Dobson 2011). Hardaliye originates from Thrace, in the European part of Turkey, where it is widely consumed (Arici and Coskun 2001; Aydoğdu, Yıldrırm et al. 2014). Its colour varies depending on the grape varieties used and the production methods (Güven and Aksoy 2009). It has an acidic taste (Coskun and Arici 2006; Aydoğdu, Yıldrırm et al. 2014).

Hardaliye is mostly home-made following the traditional method(Altay, Karbancıoglu-Güler et al. 2013). The ingredients are pressed and left to ferment for 5 to 10 days at room temperature (Kabak and Dobson 2011; Marsh, Hill et al. 2014). The microbial population of hardaliye has been reported to be mainly composed of lactobacilli and unknown fungal species (Marsh, Hill et al. 2014). Bacterial species which have been identified in naturally fermented hardaliye samples include: *Lb. paracasei* subsp. *paracasei, Lb. casei* subsp. *pseudoplantarum, Lb. brevis, Lb. pontis, Lb. acetotoleran, Lb. sanfransisco* and *Lb. vaccinostercus* (Arici and Coskun 2001).

Gilaburu Juice

Gilaburu juice is a traditional NAFB (Sagdic, Ozturk et al. 2014; Yilmaztekin and Sislioglu 2015). The basic ingredients for the fermentation are European Cranberrybush (*Viburnum opulus L.*) and water (**Table 8**). European Cranberrybush, known as gilaburu in Turkey, is a red colored fruit with special astringent taste, grown mainly around the Kayseri city in Turkey. Occasionally, sugar is added, to avoid the astringent taste. Gilaburu juice is rich in acetic acid (Yilmaztekin and Sislioglu 2015). It originates from the Kayseri province, in the central Anatolia of Turkey (Sagdic, Ozturk et al. 2014; Yilmaztekin and Sislioglu 2015).

For the preparation of the beverage, the fruits are left in water at a dark place and room temperature for about 3 to 4 months to ferment (Alizadeh, Özturk et al. 2007; Yilmaztekin and Sislioglu 2015). Several LAB species have been identified, including mainly lactobacilli, in the fermenting microbiota, such as *Lb. plantarum, Lb. casei, Lb. brevis, Lb. hordei, Lb. paraplantarum, Lb. coryniformis, Lb. buchneri, Lb. parabuchneri, Lb. pantheris and Lb. harbinensis, along withbut also Leuconostoc, e.g. Ln. mesenteroides, Ln. pseudomesenteroides* (Sagdic, Ozturk et al. 2014).

Traditional fermented non-alcoholic vegetable-based beverages

Sauerkraut juice

Sauerkraut juice or *Kraut juice* is the juice produced from white cabbage fermentation (EFSA Panel on Dietetic Products 2011) (**Table 9**). Sauerkraut juice is made from cabbage and salt, same as *Sauerkraut* (fermented cabbage) is (Albuquerque, Costa et al. 2013). Fermented cabbage juice is widely consumed in Germany (*Sauerkrautsaft),* Ukraine, Romania (*Moare*), Serbia (*Rasol*) and other regions in the Black Sea (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013). According to the common method of production, the cabbage is fermented and then the juice is pressed out. Typically, the final product contains a lot of salt. It has been shown that sauerkraut and sauerkraut juice could be prepared with a very low Na concentration as well as, with a low total mineral salt content. The sauerkraut juice, which is fermented with 0.5% mineral salt is considered to have the best taste (Karovičová and Kohajdová 2003). The natural fermenting microbiota includes mainly LAB, such as *Ln. mesenteroides, Lb. brevis, Lb.sakei* and *Lb. plantarum* (Karovičová and Kohajdová 2003; EFSA Panel on Dietetic Products 2011; Tamang, Watanabe et al. 2016).

Şalgam juice

Salgam (also spelled Shalgam or Şalgam) *juice* is a NAFB (**Table 9**). It is made from black or purple carrot (*Daucus carota*), turnip (*Brassica rapa*), bulgur (broken wheat) flour, sourdough, salt and water (Turker, Aksay et al. 2004). In India, a similar product, the Kanji, is produced via the natural fermentation of carrots and the addition of salt, chilies and crushed mustard. Both products owe their color to the anthocyanins present in the black carrot (Kabak and Dobson 2011). Salgam comes originally from the Cukurova province of Turkey but nowadays is consumed throughout the country (Erten, Tanguler et al. 2008), especially in Adana, Hatay and Icel (the Mediterranean region of Turkey). Recently, it has become popular in urban centers, such as Istanbul, Ankara and Izmir, as well (Tanguler and Erten 2012). Salgam juice is typically produced on a home-scale, however, small quantities are being commercially produced (Erten, Tanguler et al. 2008).

Salgam juice is red-colored, cloudy and has a sour taste. It is rich in minerals (calcium, potassium and iron), vitamins (A, C, and B group vitamins), and polyphenols content (Baysal, Çam et al. 2007; Erten, Tanguler et al. 2008; İncedayi, Uylaşer et al. 2008). Typically, salgam juice accompanies the meals (Kabak and Dobson 2011). The indigenous microbiota of naturally fermented salgam juice is mainly composed of LAB, with the predominant species being *Lb. plantarum, Lb. brevis* and *Lb. paracasei* subsp. *paracasei* (Arici 2004; Tanguler and Erten 2012). Yeasts, such as *S. cerevisie,* have been reported to contribute to the fermentation process (Baysal, Çam et al. 2007).

Traditional fermented non-alcoholic herb, spice and aromatic plant-based beverages

Kombucha

Kombucha is one of the most popular NAFB in the world (**Table 10**). Black tea and white sugar are used for its production although green tea can also be used (Reiss 1994). The drink was originally popular in China, but nowadays is consumed worldwide, showing an increasing popularity as a traditional soft drink (Blanc 1996; Cvetković, Markov et al. 2008; Marsh, Hill et al. 2014). Kombucha has a slightly sweet, carbonated, acidic taste resembling the sparkling apple cider (Dufresne and Farnworth 2000; Cvetković, Markov et al. 2008; Tamang and Kailasapathy 2010). Traditionally, it was a homemade drink and the preservation and supply of the symbiotic colony of bacteria and yeast (SCOBY) was included in the process (Dufresne and Farnworth 2000) but nowadays, it is also commercially available (Cvetković, Markov et al. 2008).

For the preparation, tea leaves are added to boiling water and left to infuse for 10 minutes. A small amount of sugar is then added in the hot tea and the preparation is left to cool. Tea fungus is added to the mixture, which is left to ferment for 1-8 weeks. After the end of the fermentation, the tea fungus is removed from the surface and kept in a small volume of fermented tea for future use (Dufresne and Farnworth 2000). Regarding the metabolites of the fermentation, the final product contains mainly acetic acid (Cvetković, Markov et al. 2008; Nguyen, Dong et al. 2015) but also gluconic and glucuronic acids, ethanol and glycerol (Blanc 1996; Liu, Hsu et al. 1996).

The microbiota of kombucha's fermentation has been examined by many research groups, which concluded that both lactic acid bacteria and yeasts are present during the fermentation (Tamang and Kailasapathy 2010), while some have reported that acetic acid bacteria also take part in the fermentation process (Marsh, Hill et al. 2014; Nguyen, Dong et al. 2015). Recently, different kombucha samples were analyzed using high-throughput sequencing and five bacterial phyla were revealed: Actinobacteria, Bacteroidetes, Deinococcus-Thermus, Firmicutes and Proteobacteria. The most abundant were Proteobacteria and the dominant genus was *Gluconacetobacter*, while *Acetobacter* was traced in lower populations. The Firmicutes were represented mostly by *Lactobacillus* genus and *Lactococcus* was found mainly in kombucha pellicles.The genera *Leuconostoc, Enterococcus, Allobaculum* were detected for the first time in kombucha samples. Actinobacteria were not found in all samples but *Propionibacterium* and *Bifidobacterium* strains were detected in early stages of kombucha fermentation, for the first time. Culture- dependent techniques do not permit the detection of microorganisms living in extreme thermophilic conditions like *Thermus* spp. (Deinococcus-Thermus), which was detected in the same study. Regarding yeasts *Zygosaccharomyces* was the dominant genus but also *Pichia, Dekkera, Kazachstaniagenera* were found in tea (Marsh, O'Sullivan et al. 2014).

Ginger Beer

Ginger beer, also known as ginger ale, is a NAFB (Kiple and Kriemhild Coneè Ornelas 2000; Madden 2008) (**Table 10**). There are many different recipes for the production of *ginger beer*, however, the basic ingredients used are ginger, lemon, sugar and yeast (Madden 2008). Other ingredients used to improve its taste, are mainly sugar, cream of tartar, dried ale or bread yeast, juniper berries (*Juniperus communis*), liquorice (*Glycyrrhiza glabra)* and chili *(Capsicum annuum* (Madden 2008). At first, ginger beer was homemade, but soon it became commercialized and nowadays is consumed worldwide (Kiple and Kriemhild Coneè Ornelas

2000; National Centre for Biotechnology Education 2002; Smith 2004; Madden 2008). It is a sparkling soft drink with acidic taste and due to its low alcoholic content, it has become popular among children (Madden 2008).

The production of ginger beer began in England in the mid-1700s (Madden 2008), while the first written recipes date from the early 19th century (The Food Timeline Library, 2000). The microorganisms responsible for the fermentation of ginger beer are LAB and yeasts (Dookeran, Baccus-Taylor et al. 2004). In particular, strains of the following genera have been identified *in ginger beer* samples, as a result of industrial fermentation: *Lactobacillus, Leuconostoc, Bacillus, Staphylococcus, Candida and Saccharomyces* (Osuntogun and Aboaba 2004).

Traditional fermented non- alcoholic sucrose-based beverages

Sima

Sima is a sucrose-based NAFB, consumed in Finland. The ingredients used for its preparation include water, lemon, raisins, white and brown sugar and dried ale or bread yeast. Sima is a fermented soft drink of sweet taste and murky appearance. Typically, it is used to mark special occasions, such as the May Day celebrations (National Centre for Biotechnology Education 2002). Due to its low alcoholic content, it is suited for consumption by children. The preparation method consists of six stages, the preparation of raw materials, boiling, cooling, straining, sugar addition and fermentation (National Centre for Biotechnology Education 2002).

Water kefir

Water kefir, also known as *Sugar kefir* or *Tibicos*, is a sucrose-based NAFB. The main ingredients used for its production are water kefir grains (a symbiosis of bacteria and yeast contained within grains), a sucrose solution, dried fruits (most commonly figs) and lemon (Gulitz, Stadie et al. 2011; Marsh, O'Sullivan et al. 2013; Laureys and De Vuyst 2014). The most prevalent theory as to the origin of the water kefir claims that the water kefir grains are formed as granules fermented from sap on the pads of the *Opuntia* cactus in Mexico, but the drink is nowadays consumed worldwide (Marsh, Hill et al. 2014). Water kefir is mostly a homemade beverage, while the grains for its preparation are usually passed from household to household (Marsh, O'Sullivan et al. 2013).

Fermentation of water kefir lasts for one or two days at room temperature and results in a cloudy, carbonated and straw colored drink (Gulitz, Stadie et al. 2011). The product is lightly carbonated

and acidic (Gulitz, Stadie et al. 2011; Marsh, O'Sullivan et al. 2013). The microorganisms responsible for the water kefir fermentation are LAB, acetic acid bacteria and yeasts (Franzetti, Galli et al. 1998; Laureys and De Vuyst 2014). Recently, two research groups published the microbiological analysis of water kefir samples, using high-throughput sequencing techniques (Gulitz, Stadie et al. 2013; Marsh, O'Sullivan et al. 2013). Interestingly, the microbiota analysis has given different results probably due to the different origin of the samples. In the samples from UK, USA and Canada three bacterial phyla were identified: Actinobacteria, Firmicutes and Proteobacteria. Proteobacteria were predominant in the grains, while Firmicutes were more abundant in the fermentates. *Zymomonas* genus was dominant in all the samples, with next common the *Lactobacillus* genus. *Leuconostoc* was traced, but lactococci were not found. *Acetobacter* and *Gluconacetobacter* were also present. Bifidobacteriaceae were identified in small amounts but they could not be identified to the genus level (Marsh, O'Sullivan et al. 2013). Gullitz et al. (2013), analyzed water kefir samples from different regions of Germany and according to their results *Lactobacillaceae* were the most abundant bacteria, followed by *Bifidobacteriaceae*. *Acetobacteriaceae* were traced in all the samples but in low amounts. They focused on the bifidobacteria analysis and identified *Bifidobacterium psychraerophilum* as the main species, which was also isolated (Gulitz, Stadie et al. 2013). As for the yeasts, different species have been associated with the water kefir natural fermentation. Specifically, *Saccharomyces, Hanseniaspora/Kloeckera, Zygotorulaspora* and *Candida* strains have been found in water kefir samples(Neve and Heller 2002), whereas other researchers report *Dekkera* spp. (*D. anomola, D. bruxellensis*), *Hanseniaspora* spp. (*H. valbyensis, H. vineae*), *S. cerevisiae*, *Lachancea fermentati*, *Zygosaccharomyces* subsp. *(Z. lentus, Z. florentina*) and *Meyerozyma* subsp. present in the beverage (Marsh, O'Sullivan et al. 2013; Marsh, Hill et al. 2014).

3.3 Health benefits of traditional non-alcoholic fermented beverages

The notion that the consumption of traditional NAFB is associated with health benefits is widespread; for example, kefir has a reputation for beneficial effects on gastrointestinal disorders (Tamang and Kailasapathy 2010). However, health claims are mostly based on personal experiences and testimonials of people who habitually drink these beverages while the experimental evidence is still fragmentary, as the ideal methodology for research, e.g. randomized controlled clinical trials, is not easy to apply. Most of the studies which investigated traditional NAFB and their impact on health have focused on two beverages, kefir and kombucha. Thus, the association between traditional NAFB and health has not been

scientifically proven yet. Nevertheless, as their alleged health-promoting properties are deeply rooted in the respective cultures, they deserve to be further examined via controlled clinical studies in other cultural origins and in current conditions of living.

Besides the nutrients of the raw unfermented ingredients, NAFB also contain microorganisms, as well as, metabolites and protein breakdown products (Ebringer, Ferenčík et al. 2008). The primary metabolic actions of the starter cultures in food and beverage fermentations include their ability to predominantly, ferment carbohydrates and, to a lesser degree, degrade proteins and fats in the raw material. This leads to the production of a broad range of metabolites, mainly organic acids (e.g. lactic, acetic, formic, propionic), peptides, amino acids and free fatty acids, along with many volatile and non-volatile low molecular mass compounds, such as ketones and esters. Other metabolites, such as antimicrobial compounds (e.g. carbon dioxide and ethanol as well as antimicrobial peptides and proteins known as bacteriocins), exopolysaccharides, enzymes (e.g. amylases) and vitamins are also often produced. This way, starter cultures enhance the product's shelf-life and microbial safety (Leroy and De Vuyst 2004).

In recent years, a special category of starter or adjunct microorganisms, the so-called probiotics, have been recognized to be involved in food fermentations (Khani, M Hosseini et al. 2012). Probiotic foods and beverages are considered as health-promoting foods and belong to the so-called functional foods with large and expanding commercial interest. As presented in the above section, many traditional NAFB are good sources of probiotics. Probiotics mainly belong to the lactic acid bacteria group and when taken up in adequate amounts confer a health benefit on the host (Tamang, Shin et al. 2016). Even if it is not easy to declare health promoting effects, probiotics have been implicated in the management of gastrointestinal tract diseases, alleviation of lactose intolerance, reduction of the risk for certain types of cancer, treatment of ulcerative colitis and *Helicobacter pylori* infection, whereas they have been suggested to exert antihypertensive and hypocholesterolic effects (Takano 2002; Elmadfa, Klein et al. 2010; Khani, M Hosseini et al. 2012). Some of the aforementioned effects are supported by clinical studies, however, issues such as the site and mode of action, viability, effectiveness after food handling and storage and the minimum quantity necessary to promote a health effect are still under examination (Mercenier, Pavan et al. 2003). Attributed and evidence based health benefits of the various categories of NAFB are presented in the following sections.

Traditional fermented low- and non- alcoholic milk-based beverages

Same as milk, fermented milk products are also good sources of proteins, lipids and carbohydrates; in addition, they contain bioactive compounds, most importantly immunoglobulins, bioactive peptides, hormones, cytokines and growth factors (Neve and Heller 2002). This complex mixture of substances influences many biological functions, such as the stimulation of cellular proliferation and gastrointestinal function and maturation in the postnatal state, contributing to the adaptation of the newborn child (Neve and Heller 2002). Fermented milks are also rich in exopolysaccharides, such as kefiran in kefir, which are considered to have a beneficial impact, especially as antioxidant, antitumor, antimicrobial and immunomodulating agents (Hugenholtz 2013; Tamang, Shin et al. 2016). Thus, the superiority of fermented against non-fermented milk stems from its microbiota and bioactive compounds.

Fermented dairy products help in the alleviation of lactose intolerance, not only because they have a reduced lactose content compared to milk, but also due to the secretion of bacterial lactase from LAB stains into the stomach and intestine (Khani, M Hosseini et al. 2012). In children with acute diarrhea and carbohydrate malabsorption, the gastrointestinal diseases and most importantly the decreased duration of acute diarrhea and stool frequency, were shown to be associated with the feeding of yoghurt, while the cessation of diarrhea and weight gain of these children were similar to either yoghurt or milk feeding groups (Boudraa, Benbouabdellah et al. 2001). Fermented milk can also be valuable in complementary feeding, targeting the prevention of iron deficiency anemia and also the prevention and shortening the length of gastrointestinal infections *via* the action of probiotics. Furthermore, fermented milk can contribute to the prevention of malnutrition in young children living in regions with limited access to animal origin foods, high prevalence of parasites, low hygiene level in food handling and unsafe drinkable water (Branca and Rossi 2002; Solis, Samartin et al. 2002).

Natural fermented milks have been examined for a number of health promoting effects. Kefir in particular, has been accredited with the ability to normalize the intestinal microbiota and reduce the symptoms of lactose intolerance (Lopitz-Otsoa, Rementeria et al. 2006; Özdestan and Üren 2010; Tamang 2010; Tamang and Kailasapathy 2010; Kabak and Dobson 2011; Leite, Miguel et al. 2013). With regard to gastrointestinal diseases, in Russia, kefir has been routinely administrated for the treatment of peptic ulcers (Farnworth 2008). The administration of kefir in an animal model was associated with significantly increased number of LAB and reduced number of enterobacteria and clostridia (Marquina, Santos et al. 2002). Kefir's antimicrobial activity against a wide variety of gram-positive, gram-negative bacteria and fungi, some of them

being considered as foodborne pathogens or food spoilage microorganisms, is related to compounds, such as lactic acid, carbon dioxide, volatile acids and bacteriocins (Tamang and Kailasapathy 2010; Altay, Karbancıoglu-Güler et al. 2013). Similarly, ayran, a salt-containing yoghurt drink, is a vehicle of viable lactic acid bacteria such as *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophiles* (Morelli 2014). Yoghurt's potential to alleviate symptoms of lactose intolerance has been well documented and is considered to be a species-related trait of lactic acid bacteria (Tamang, Shin et al. 2016). In men with lactose malabsorption, the chronic consumption of a fermented dairy product (yoghurt) was associated with alleviated symptoms and decreased breath hydrogen status (Rizkalla, Luo et al. 2000). Other strain-specific health properties of traditional yoghurt living cultures are the immunomodulatory impact of a *L. bulgaricus* specific strain supported by both *in vitro* and *in vivo* studies(Makino, Ikegami et al. 2010). The end-products of kefir fermentation, namely the peptides derived from a mild proteolysis of the milk caseins, have been found to be associated with immunomodulating activity on the gut and stimulation of the immune system in mice (Vinderola, Perdigón et al. 2006). For the case of antibiotic associated diarrhea however, a clinical trial, the kefir (MILK) study, failed to show a positive impact on its prevention when kefir was administered (Merenstein, Foster et al. 2009).

Besides the effects related to the normalization of the intestinal microbiota, natural fermented milks have been examined for their potential to protect against cardiovascular risk factors (Tamang JP 2010; Tamang, Shin et al. 2016). In an animal study in hypercholesterolemic rats, the oral administration of kefir resulted in reductions of VLDL, LDL cholesterol and TG levels and increased HDL cholesterol levels (Angelis-Pereira, Barcelos et al. 2013). Similar results emerged from another study with cholesterol-fed hamsters, in which kefir was associated with lowered levels of TG, total cholesterol, cholesterol accumulation in the liver and non-HDL fraction (Liu, Wang et al. 2006). Furthermore, kefiran, the exopolysaccharide of kefir, has been associated with prevention of atherosclerosis in rabbits fed with a high cholesterol diet (Uchida, Ishii et al. 2010). On the contrary, a clinical study with mildly hypercholesterolemic men, who consumed kefir, did not result in low levels of plasma lipids (St-Onge, Farnworth et al. 2002). Apart from natural fermented milks, functional fermented milks with strains isolated from naturally fermented dairy products have also been used in order to improve serum lipid levels (Hugenholtz 2013). Recently, it has been shown that the addition of a *Lactobacillus helveticus* strain isolated from fermented cow milk in the diet of hypercholesterolemic mice was associated with the reduction of serum total cholesterol level, while a significant decrease in LDL cholesterol level was also observed (Damodharan, Palaniyandi et al. 2016).

Furthermore, an antihypertensive effect of fermented milks has also been shown *in vivo*, in both human studies and animal models (rats); this effect is believed to be mediated by the production of ACE (Angiotensin Converting Enzyme) inhibitory peptides (antihypertensive bioactive peptides) released during fermentation (Domínguez, Cruz et al. 2014). Beltrán-Barrientos et al. reviewed seven different clinical trials that assessed the effect of fermented milk consumption on the blood pressure and concluded that significant decreases of the blood pressure were noticed and that they can be attributed to the use of *Lactobacillus helveticus* strains (Beltrán-Barrientos, Hernández-Mendoza et al. 2016). On the contrary, a clinical trial among type 2 diabetes patients who were randomly assigned to receive daily a fermented milk with *L. helveticus* for 12 weeks, failed to show any significant reduction in the blood pressure after the consumption of this «functional» milk (Hove, Brøns et al. 2015).

Some experimental evidence exists for other purported health benefits of milk-based NAFB, such as their impact on obesity. An *in vitro* study has shown that kefir could act as a regulator for obesity, due to the inhibition of the adipocyte differentiation (Ho, Choi et al. 2013). Another study using genetically obese mice (ob/ob), suggested that oral administration of kefir was associated with suspension of lipogenesis, and thus, protection against non-alcoholic fatty liver disease (Chen, Tung et al. 2014). With regard to yoghurt's effect to prevent weigh gain, the SUN (Seguimiento University of Navarra) cohort study has shown that there is an inverse association between its consumption and the incidence of overweight and obesity in adults, especially when yoghurt is part of a healthy dietary regimen and is accompanied by high fruit consumption (Martinez-Gonzalez, Sayon-Orea et al. 2014). Furthermore an observational, cross-sectional study that was conducted among adolescents in eight European cities (HELENA) showed that consumption of dairy products, including milk, yoghurt and fermented milks was inversely associated to total and abdominal excess body fat (Moreno, Bel-Serrat et al. 2015).

The impact of the consumption of fermented milks on bone metabolism and bone mineral density has also been investigated. In a double-blind cross over study, the consumption of fermented milk with *Lactobacillus helveticus* by 20 postmenopausal women had a positive acute effect on their calcium metabolism, compared to milk consumption and to juice containing peptides formed by the same strain (Narva, Nevala et al. 2004). A recent clinical trial measured the effects of kefir supplemented with calcium bicarbonate on bone mineral density and metabolism in 40 osteoporotic men and women for six months, and compared them with unfermented raw milk also supplemented with calcium bicarbonate. The kefir consumption was associated with improved bone mineral density and with significantly increased serum parathyroid hormone (Tu, Chen et al. 2015). In a study with an ovariectomized rat model having

postmenopausal osteoporosis, it was observed that a 12-week treatment with kefir could be beneficial to the prevention or treatment of osteoporosis (Chen, Tung et al. 2015).

Another health effect that has been attributed to fermented milk products is their antioxidant capacity. In this respect, results from an *in vitro* study using human colon cells has found that both kefir and ayran have an antioxidant potential that may prevent DNA damage (Grishina, Kulikova et al. 2011). When administered in diabetic rats, kefir was associated with reduced oxidative stress, and improved renal function, one of the main diabetic complications (Punaro, Maciel et al. 2014).

From the above it can be concluded that the published evidence on fermented milks provides substantial ground for supporting the potential of these beverages to modulate gut microbiota and thus, improve the gastrointestinal function. The evidence on other health benefits, such as the impact on cardiovascular disease risk factors and osteoporosis is weak and therefore, these claims require further evaluation.

Traditional fermented non-alcoholic cereal-based beverages

The impact of the consumption of traditional cereal-based NAFB on health has also received attention. These beverages are sources of nutrients and other substances, such as minerals, vitamins, fibers, flavonoids and phenolic compounds, which could protect from oxidative stress, inflammation, hyperglycemia and tumorgenesis (Taylor and Duodu 2015). Moreover, their microbial content and metabolites may also contribute to their health promoting effects. In particular, boza has been found to have probiotic properties (Gotcheva, Pandiella et al. 2001; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Todorov, Botes et al. 2008; Yeğin and Üren 2008; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013), while the various metabolites of LAB that it contains, such as lactic acid, confer antimicrobial properties and positive effects on digestion and intestinal microbiota (Arici and Daglioglu 2002; Yeğin and Üren 2008).

Traditional fermented non-alcoholic fruit-based beverages

The data concerning the potential health effects of traditional fruit-based NAFB are scarce. Recent research has found that the European Cranberrybush (*Viburnum opulus L.*), the main ingredient of gilaburu juice, is rich in antioxidants and has antimicrobial properties (Andreeva, Komarova et al. 2004; Levent Altun, Saltan Çitoğlu et al. 2008; Sagdic, Ozturk et al. 2014).

Furthermore, its juice may be chemopreventive at the early stages of colon cancer, as reported from the treatment of mice after DMH-induced colon cancer (Ulger et al. 2013). Furthermore, because it contains several LAB species, gilaburu juice is deemed to have a probiotic potential (Sagdic, Ozturk et al. 2014; Yilmaztekin and Sislioglu 2015). According to the results of a randomized controlled clinical trial, hardaliye exhibits antioxidant activity (Amoutzopoulos, Löker et al. 2013).

Traditional fermented non- alcoholic vegetable-based beverages

Among the various vegetable-based NAFB, data exist only for sauerkraut juice. More specifically, research has been conducted to test its role in helping digestion, normalizing the function of the stomach and gut, as well as in providing antimicrobial, antioxidant and antitumor effects (Tamang, Shin et al. 2016). The health promoting components of sauerkraut juice and its impact on health have been studied in a few *in vitro* and *in vivo* animal studies (EFSA Panel on Dietetic Products 2011). An *in vitro* study has shown that sauerkraut juice, which was produced *via* short and prolonged fermentation by lactic acid bacteria, had a more pronounced antioxidant effect compared to non-fermented cabbage (Kusznierewicz, Śmiechowska et al. 2008). Also, an animal study has indicated that the chemoprotective properties of sauerkraut juice may be attributed to the activation of the detoxifying enzymes (Krajka-Kuźniak, Szaefer et al. 2011). Another animal study which examined rat liver and kidneys, has shown that sauerkraut juices may have anticarcinogenic and chemopreventive effects *via* the inactivation of carcinogens/xenobiotics (Szaefer, Krajka-Kuźniak et al. 2012). However, the above evidence needs to be enriched with additional data, in order for the health claims about sauerkraut juice to become substantiated.

Traditional fermented non-alcoholic herb, spice and aromatic plant-based beverages

The proposed health effects of kombucha, a fermented sweetened tea, have been attributed firstly to the protective impact of tea itself, and secondly to the products formed during the fermentation, namely its content in glucuronic acid, acetic acid, polyphenols, phenols and B-complex vitamins, including folic acid (Dufresne and Farnworth 2000; Wang, Ji et al. 2014). The acid content of kombucha resulting in reduced pH, in conjunction with antimicrobial substances produced by the bacteria and the alcohol (although it is not always detected), may have an antimicrobial and curative potential (Marsh, Hill et al. 2014). Glucuronic acid, an end product of

kombucha's fermentation, is thought to be one of the key components for its proposed health effect on liver and gastrointestinal function and also on immune stimulation (Wang, Ji et al. 2014). D-saccharic acid-1,4-lactone (DLS), which is produced from *Gluconacetobacter sp. A4* (a microorganism found in kombucha), may facilitate glucuronic acid to exert detoxifying, antioxidant and antitumor properties. Wang *et al* have found that the hepatoprotective properties of kombucha are attributed to the presence of DLS in it and also that *Gluconacetobacter sp. A4* is the key functional strain responsible for these protective effects (Wang, Ji et al. 2014).

Other recent *in vitro* and *in vivo* experimental studies, mainly in mice and rats, have also reported that kombucha may exert health prophylactic and recovery effects, through immune stimulation, detoxification, antimicrobial activity, as well as antioxidation (Dufresne and Farnworth 2000; Greenwalt, Steinkraus et al. 2000; Tamang JP 2010; Vīna, Semjonovs et al. 2014). One study has shown that kombucha was more efficient to revert the CCl_4-induced hepatotoxicity in rats when compared both to black tea and to enzyme-processed tea with tea fungus; this was attributed to the antioxidants produced during the fermentation process (Murugesan, Sathishkumar et al. 2009). Furthermore, the antioxidant capacity of polyphenols, mainly flavonols and catechins found in kombucha, may prevent the development and inhibit the progression of many chronic human diseases, including cancer, cardiovascular disease, diabetes and neurodegenerative diseases. The availability of B-complex vitamins and especially folic acid in kombucha may also contribute to the normal central nervous system function at all ages and help towards the prevention of disorders related to central nervous system (Dufresne and Farnworth 2000; Greenwalt, Steinkraus et al. 2000; Tamang JP 2010; Vīna, Semjonovs et al. 2014). As the majority of the data on kombucha's effects arise from *in vitro* and *in vivo* (animal) studies, human clinical studies are needed in order to clarify its health benefits and the mechanisms of action.

Apart from kombucha, advocates of ginger beer have attributed health benefits to this beverage, especially counterirritant properties and a capacity to alleviate the symptoms of upset stomach (The.Food.Timeline.Library 2000; Smith 2004). However, its impact on health has not been evaluated yet.

Traditional fermented non-alcoholic sucrose-based beverages

The evidence about the two sucrose-based NAFB, water kefir and sima, is very fragmentary and limited to water kefir. Water kefir is believed to be a health-promoting beverage. It contains strains from species, such as lactobacilli and bifidobacteria, which are generally considered to

have probiotic properties(Gulitz, Stadie et al. 2013). Up to date however, the research on water kefir is very limited and its health benefits have yet to be investigated (Marsh, O'Sullivan et al. 2013). Evidence on the health promoting effects of sima, another traditional sucrose-based NAFB, is completely missing.

3.4 Potential health risks of traditional non-alcoholic fermented beverages

Even though the consumption of non- or low- alcoholic fermented beverages is generally considered safe, there are some aspects arising from toxic compounds traced in fermented milks and cereal- based fermented products. The main substances found with toxic activity depending on their concentration, are biogenic amines, such as tyramine, putrescine, cadaverine, spermidine and histamine. They are produced by lactic acid bacteria of *Enterococcus*, *Lactobacillus*, *Leuconostoc* and other genera, via the decarboxylation of amino acids. The consumption of foods containing biogenic amines might represent a health risk for patients with neurodegenerative diseases treated with monoamine oxidase inhibitor drugs (Fernández, Hudson et al. 2015).

In a survey conducted in kefir samples from different producers, a number of biogenic amines were traced. Total amines varied from 2.4 to35.2 mg/L and tyramine, was the predominant, traced in almost all the samples. Putrescine, cadaverine and spermidine were also detected. Based on the current knowledge, their concentrations in the examined samples do not seem to be of great concern (Özdestan and Üren 2010). In another study searching biogenic amines in boza samples from different producers, putrescine, spermidine and tyramine were found in all samples. Total biogenic amines concentration varied between 25 and 69 mg/kg; tyramine was the dominant amine (Yeğin and Üren 2008). As there are no data regarding the association between the consumption of these beverages and toxicity, more experimental evidence is required. Furthermore, the attributed toxic activity of biogenic amines poses the need for regulatory authorities to adequately standardize their concentration limits in traditional non- or low- alcoholic fermented beverages.

For kombucha, there are a few reports associating daily consumption with stomach upset, or allergic reactions. The mechanism connecting the causality of kombucha consumption to these adverse effects has not been yet proposed, but the cessation of its intake ameliorated the health status of these patients (Srinivasan, Smolinske et al. 1997; Frank 1998). A case of cutaneous anthrax has also been associated to unhygienic kombucha tea exposure in Iran (Sadjadi 1998). Some health disorders, such as hepatotoxicity and severe metabolic acidosis, have been linked to

kombucha consumption, possibly after chronic or excessive consumption (Greenwalt, Steinkraus et al. 2000; Hartmann, Burleson et al. 2000). Recently, a case of hepatotoxicity related to kombucha consumption was published (Gedela, Potu et al. 2016). Finally a pilot study in mice reported some adverse effects, such as splenomegaly and hepatomegaly, after chronic kombucha injection (Hartmann, Burleson et al. 2000).

Regarding kvass, a cereal-based beverage popular in Russia and other countries, concerns have been published for its possible contribution to chronic alcoholism in the former Soviet Union. Kvass content of alcohol is generally below 1.5%, but due to its low price has been massively consumed even by adolescents and children (Jargin 2009).

3.5 Commercialisation of indigenous non-alcoholic fermented beverages

Traditional non- alcoholic fermented beverages and their place in the market.

Low- alcoholic fermented beverages have gained the consumers' acceptance worldwide. Their demand stems from long rooted established practices, as well as, their sensorial properties. In the past, NAFB were found mainly in rural markets, such as small and large-scale farms and local village markets, but recently have become available in urban markets as well. A variety of NAFB are commercially available in many cities (Perricone, Bevilacqua et al. 2014). (**Tables 6,7,8,9,10)**. Most of them are dairy, for instance Kefir (Marshall 2011). Examples of other than dairy NAFB, which are commercially available in European markets, are the kvass and the kombucha.

In countries where a standardized production for NAFB exists, their consumption has exhibited an increase over the past decades. Dairy fermented beverages, with fermented milks and yoghurt-like drinks being the most representatives, comprise the majority of the health-promoting fermented beverages. Dairy NAFB are widely consumed in northern European countries, such as Denmark, Sweden and Finland (Ozen, Pons et al. 2012) (**Figure 4**), but are less consumed in other countries such as France, German, Spain and the UK (Perricone, Bevilacqua et al. 2014). Based on a series of studies focusing on the level of consumption of commercially produced fermented milk products in different countries, Finland had the highest level, with 91,6% of the participants reported consuming sour milk (Lahti-Koski, Pietinen et al. 2002; Marsh, Hill et al. 2014). Thus, the implementation of standards in the manufacturing of traditional NAFB not only ensures the identity and quality of these products, but also helps in promoting their consumption in the general population.

Innovations and perspectives of traditional non- alcoholic fermented beverages

Over the last decade, an increasing demand for health-promoting foods and beverages has been reported in many parts of the world (Perricone, Bevilacqua et al. 2014). This resulted in the expansion of ‘’functional’’ foods throughout the market, with a wide range of products, including beverages. Generally, there is no unanimously accepted international definition of ‘’functional’’ foods. From a science-based view, the European Commission Concerted Action on Functional Food Science in Europe (FuFoSE) describes a food as functional “if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either an improved state of health and well-being and/or reduction of risk of disease”. It also states that “functional’’ foods must remain foods and they must demonstrate their effects in amounts that can normally be expected to be consumed in the diet: they are not pills or capsules but part of a normal food pattern”(Action 1999). This prerequisite represents a challenge when attempting to formulate legislations for regulating the market of functional foods (Perricone, Bevilacqua et al. 2014).

Dairy foods are estimated to account for almost 43% of the functional foods market, the largest portion of which comprises of fermented products (Özer and Kirmaci 2010). The majority of fermented milks and yoghurt-like drinks fall within the category of probiotic beverages, the largest proportion of the functional food market (Marsh, Hill et al. 2014; Perricone, Bevilacqua et al. 2014). These beverages often contain strains of *Lactobacillus* spp. and *Bifidobacterium* spp., as well as other species. In their novel versions, *Lb. acidophilus*, *Lb. rhamnosus*, *Lb. casei* and *B. bifidum* are the most commonly added probiotics (Maukonen, Alakomi et al. 2006; Özer and Kirmaci 2010; Perricone, Bevilacqua et al. 2014), while peptides, phytosterol, minerals and milk whey are the most commonly added bioactive compounds (for examples see **Table 11**). In some cases, species of *Saccharomyces* and *Candida* may be added in commercially prepared fermented milks (Gadaga, Mutukumira et al. 2001), but only *Saccharomyces boulardii* is considered as a yeast with probiotic properties. More recently, the production of probiotic fermented beverages from whey has received a lot of attention (Luana, Rossana et al. 2014). A representative example of fermented whey-based drink is Gefilus ® (Valio Ltd., Finland) (**Table 11**). Whey is an end-products of cheese manufacturing (a fermentation process), which retains almost half of the milk nutrients and is low in fat (0.36%). A fermented whey-based drink can be produced by the addition of LAB, such as *Streptococcus* and *Lactobacillus*, on whey. These probiotic bacteria can survive and ferment whey (Drgalic, Tratnik et al. 2005). Furthermore, it has been shown that the addition of starter cultures, such as kefir grains, can also result in the production of a fermented whey-based beverage (Luana, Rossana et al. 2014).

The prospect of manufacturing non-dairy fermented beverages is currently very appealing, mostly as an alternative way to traditional dairy-based fermented beverages for delivering probiotics. Non-dairy beverages containing probiotic strains have recently been launched in the European market. Made of fruits, vegetables and cereals, these beverages are suitable for persons allergic to milk, hypercholesterolemics as well as, for vegans, while they are good sources of antioxidants, fibers, vitamins and minerals (Prado, Parada et al. 2008). At the same time, they are free from substances found in dairy products, such as pesticides, estrogen and insulin-like growth factor I (IGF-I) which might be responsible for a negative association between dairy products and health problems (Perricone, Bevilacqua et al. 2014).In particular, cereals serve as alternative substrates for the industrial production of non-dairy fermented beverages which contain probiotic and prebiotic ingredients (Luana, Rossana et al. 2014). Proviva® (Skane Dairy, Sweden) was the first non-dairy fermented probiotic beverage, made of oatmeal gruel with the addition of LAB (Prado, Parada et al. 2008) (**Table 11**).

Ongoing research for developing new formulas for dairy and non-dairy NAFB products results in an expansion of the types available, beyond the traditional ones (Prado, Parada et al. 2008) . Further evidence, which will substantiate their preventive or/and therapeutic health benefits, mode of action, optimal intake, selection of specific strains for a targeted outcome and mode of delivery is needed. Also, information regarding the viability, metabolic activity and thus efficacy of probiotic bacteria in a beverage till the end of shelf-life has to be considered. New product development requires detailed knowledge of the products' details as well as the customers' needs and behavior (Heenan, Adams et al. 2004; Yoon, Woodams et al. 2006).

3.6 Discussion

NAFB are important constituents of the human diet all around the world. Their value stems from their cultural significance, as their production has been interwoven with ecosystems and social structures of local communities (Yoon, Woodams et al. 2006; Shiby and Mishra 2013). In Europe, NAFB produced from milk are the most abundant, with kefir, ayran and buttermilk being among the most representative ones. NAFB made of cereals (such as boza and kvass), herbs, spices and aromatic plants (such as Kombucha and ginger beer) as well as, sucrose-based (such as sima and water kefir) are also popular in some countries; NAFB made of fruits (such as hardaliye and gilaburu juice) and vegetables (such as sauerkraut juice and salgam juice) are generally less well known.

By applying the process of fermentation the nutritional value of the substrates of fermentation, milk, fruit, cereals and vegetables, can be modified *via* a spontaneous biological enrichment with essential amino acids, vitamins and bioactive compounds (Tamang and Kailasapathy 2010). For example, in fermented milks, via the process of biological enrichment, most of the lactose is converted to lactate and proteins to free amino acids, both of which are readily absorbed, thus enhancing the digestibility of the product (Campbell-Platt 1994). However, although consumption of NAFB has received attention, information on their nutrient content is generally lacking. Thus, compiling information on the composition and nutritional value of NAFB is important in order to properly update (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013). Furthermore, this knowledge will allow government authorities to compile scientifically based regulation requirements, beverage industries to promote these beverages based on information, nutritionists and dietetics in dietary planning and consultation, and finally scientists in research designing and explaining study results. In addition, a robust knowledge of traditional NAFB from the European countries will assist in the promotion of regional biodiversity and sustainability.

NAFB produced in European regions are usually from cow milk (**Table 6**). However, at a global level, non-cow milk (NCM) has a growing importance in production, culture, economy and ecology (Faye and Konuspayeva 2012). NCM is widely produced and consumed in Asia and Africa (approximately 50% of the produced milk), mainly in emerging or developing countries and in remote areas(Food and Agriculture Organization of the United Nations 2015). In Europe the majority of the produced NCM comes from sheep (Faye and Konuspayeva 2012). Several of the milk-based NAFB presented in **Table 6**, can be made from types of milk, other than cow milk, such as sheep (sour milk, skyr, prokish, prostokvasha, lyntyca, Žinčica), camel (kefir), buffalo (sour milk) or goat milk (Bulgarian buttermilk). Thus, milk-based NAFB may represent an opportunity in the direction of poverty alleviation and environmental sustainability by contributing to the increasing demand for food quantity and quality, especially in poor and under-developed countries.

In the past, alleged health effects had been sufficient for the consumption of NAFB. Nowadays, their link to health benefits requires evaluation. Well designed studies could investigate the impact their consumption has on human health and elicit the role of their bioactive ingredients, type of microbes and their content and by-products of fermentation, as their health effects are probably the result of a synergistic process (Shiby and Mishra 2013; Corbo, Bevilacqua et al. 2014; Marsh, Hill et al. 2014; Perricone, Bevilacqua et al. 2014). Many factors perplex the implementation of clinical trials: constrains of time and money, the required adherence by the

participants to consume the prescribed beverage and the selection of appropriate placebos (both for NAFB and diet regime). However, the need for strict and standardized guidelines in designing and conducting experimental studies is necessary.

Generally, NAFB are an under-searched group of foods. The great diversity observed in traditional NAFB can be attributed to several factors, such as utilization of different raw materials, variations in natural microbiota and fermentation conditions, and production methods applied (Altay, Karbancıoglu-Güler et al. 2013). Our understanding would be facilitated by establishing a consensus with respect to the specification of the natural microbiota, description of these particular microorganisms that are essential for fermentation, as well as their contribution, either as a consortium or as a single strain to the final composition of each beverage(Marsh, Hill et al. 2014). Currently, the formulation of health drinks that are based on traditional NAFB represent a challenging opportunity for the beverage industry.

Most of the NAFB presented here have been only recently become available in the market. Thus, in order for the scientific and commercial food standards to be met, there is a need for improving their microbial and sensorial properties. The design and production of a second generation NAFB requires the following actions: (1) the identification, quantification and standardization of promising bioactive compounds, (2) the fingerprinting and characterization of the indigenous microbiota of the artisanal products, (3) the selection of starters able to produce bioactive compounds, (4) the selection of strains with functional properties to enhance the health promoting properties of traditional NAFB, (5) the investigation of bioavailability and metabolism of ingredients with health promoting potential, (6) the study of safety aspects related to the consumption of beverages with enhanced nutritional effects and (7) the formulation of value-added products based on traditional NAFB (Altay, Karbancıoglu-Güler et al. 2013; Corbo, Bevilacqua et al. 2014). These developing actions in the health promoting beverage market need to rely on a collaborative effort between industry partners and academia. This way, clinical trials and solid evidence, will guarantee the production of NAFB with enhanced nutritional effects and justified health claims (Khan, Grigor et al. 2013).

However, many of the fermented foods are still produced in the traditional manner, i.e. either by natural spontaneous fermentations or by employing the back-slopping method (Robinson R K 2006; Silk, Guo et al. 2006; Farnworth 2008; Tamang and Kailasapathy 2010). Back-slopping results in a higher initial number of microbiota present in the raw material itself. The specific microbiota involved in the production of any particular NAFB varies markedly from region to region, and even among households within small geographical regions. Furthermore, taking into

consideration the existing variability in the processing parameters, which are also being employed between the different fermentation regimes and geographical regions, one may conclude that the achievement of a uniform NAFB is an extremely difficult task. The above indicate that further research is needed in order to determine the microbiological and biochemical features of the traditional NAFB in each European country. As industrialization and urbanization is currently the norm for the European societies, there is a need for large-scale production, that will result in traditional fermented beverages of a consistently high quality and safety (Haard 1999). The transition from a household procedure to an industrial scale production is a complex process, which requires improvements in the process controls and the overall quality and safety, such as the microbiological standpoint of the raw materials used in the production of these beverages.

Nowadays, many people in western societies wish to follow a prudent lifestyle. NAFB could be an integral part of this trend as they are linked to a traditional, sustainable food system while they may be capable to improve the nutritional status of many (Vietmeyer 1992). As the scientific knowledge on the role of probiotics expand, the need for alternative means of probiotic delivery also increases. The various dairy products are currently the vehicle of choice for delivering probiotics, and probiotics are responsible for the health benefits of many NAFB. Furthermore, cheese whey is an inexpensive fermentation substrate with high nutritional value and some whey components, such as lactoferrin, growth factors, and immunoglobulins are gaining commercial interest from the beverage industry (Özer and Kirmaci 2010). Thus, whey-based fermented beverages could constitute a larger part of the European commercial beverages (Jeličić, Božanić et al. 2008; Bulatović, Rakin et al. 2014). In addition, NAFB based on substrates other than milk, such as cereal and fruit juices may also gain success among consumers. Cereal-based fermented drinks could be produced commercially in Europe and low-quality cereals could be used for the production of a highly nutritive product (Gotcheva, Pandiella et al. 2001).

The interest of consumers for the preparation and consumption of traditional NAFB depends on their potential to have a good taste, to prevent disease and ensuring healthy lives and well-being at all ages (Koletzko, Aggett et al. 1998; Özer and Kirmaci 2010; Corbo, Bevilacqua et al. 2014). Full regulatory approval for claims requires the support of robust evidence (Lalor and Wall 2011). The European Food Safety Authority (EFSA), in accordance with Regulation (EC) No 1924/2006, has also set scientific requirements for substantiating health claims related to gut and immune functions (Parliament 2006). However, in the USA and Japan a health claim that is suggested but not supported by robust evidence is known as a qualified health claim and is

permitted. This heterogeneity in the required evidence has resulted in diverse health claims being accepted by the competent agencies among different counties even in the same continent and eventually creates confusion to the consumer. Currently, only in a few European countries, for instance Sweden, the United Kingdom and the Netherlands, existing regulations allow for an official approval of health claims (Saxelin 2008). Once the constitution of the new regulation from the European Union is in place, the use of unauthorized claims and promises will cease, thus ensuring the development of accurate claims in regards to the health benefits of products that target to specific health conditions (Shiby and Mishra 2013; Corbo, Bevilacqua et al. 2014; Marsh, Hill et al. 2014; Perricone, Bevilacqua et al. 2014).

3.7 Conclusion

Historically, NAFB produced and consumed by European populations, have been important for their nutrition and well-being. The present review revealed a considerable variety of traditional NAFB across Europe. Although the dietary significance for some of these beverages is well known, there are still much to be elicited, especially about those of marginal use. Moreover, the stock of local knowledge on the natural preparation processes of these traditional beverages appears to be at risk, because of the overreliance on commercially produced beverages which currently prevails, even in rural regions. This trend, combined with a decline in the transfer of knowledge and lack of documentation on the remaining traditional know-how concerning local microbiota, ingredients of fermentation and fermentation processes, has resulted in the marginalization, and in some case, even disappearance of homemade NAFB today.

From a commercial perspective, an increasing interest in beverages with enhanced nutritional effects has made selected traditional milk-based NAFB, such as kefir and ayran, widely available in many European markets. The health beverage market will benefit from the increase of knowledge on less widespread traditional NAFB, such as those that are presented in this review. Based on the improvements in science and technology, as well as and consumers' increasing consciousness for healthy and sustainable diets, the future for NAFB appears to be more promising than ever.

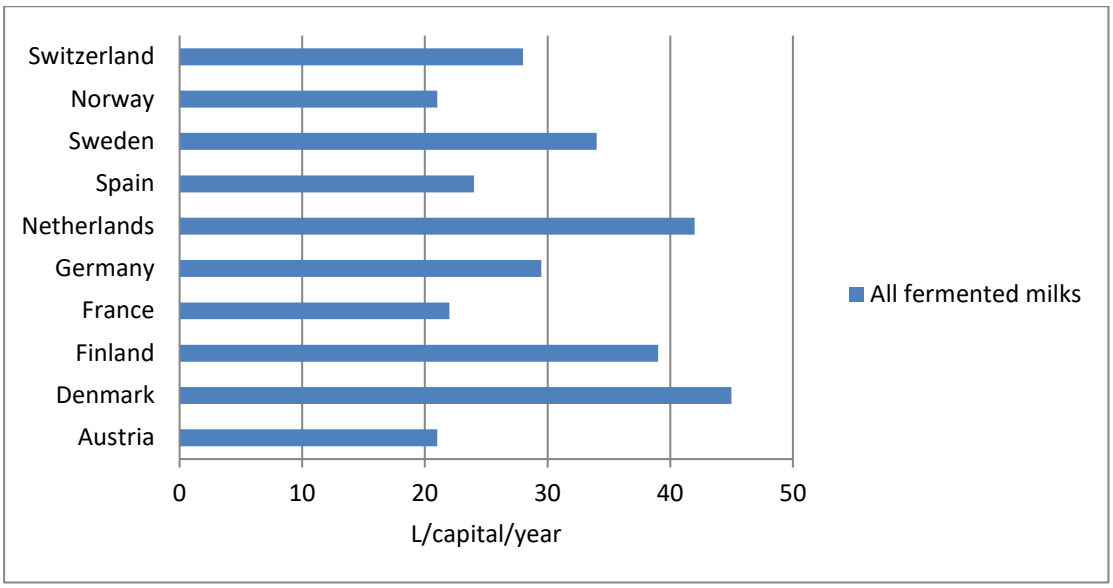


Figure 4. Annual per capita consumption of all fermented milks only in selected countries in Europe. Data were taken from Saxelin M (2008) (Saxelin M 2008).

Table 6. Examples of traditional milk-based NAFB consumed in European countries.

Name	Substrate	Sensory property and nature	Alcoholic content	Other metabolites	Nature of use	Nutrition data	Microbiota of fermentation	Functional properties	Country of consumption in Europe	Status of fermentation (homemade/ industrialized)
Kefir	Any kind of milk (goat, sheep, cow, camel, buffalo) and milk substitutes, such as soy milk, rice and coconut milk (Tamang and Kailasapathy 2010; Kabak and Dobson 2011; Panesar 2011; Altay, Karbancıoglu-Güler et	Self-carbonated, viscous, uniform creamy and elastic consistency, sour, acidic and slightly alcoholic, tart flavour, perceptible yeast aroma, slightly foamy body and white or yellowish color (Lopitz-Otsoa, Rementeria	Usually below 2% (Özdestan and Üren 2010; Tamang and Kailasapathy 2010; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013)	Lactic acid, ethanol, CO2, volatile acids, acetaldehyde, diacetyl and acetoin, biogenic amines (Lopitz-Otsoa, Rementeria et al. 2006; Özdestan and Üren 2010; Tamang and Kailasapathy 2010; Kabak and Dobson	Easily digested, effervescent fermented milk beverage (Lopitz-Otsoa, Rementeria et al. 2006; Melo and Silva 2014; Wolfe and Dutton 2015) with health-promoting effects	Per 100 g. : protein 3.0–3.4 g., fat 1.5 g and lactose 2.0–3.5 g, lactic acid 0.6- 1.0 mL/100mL (Robinson R K 2006), B1, B12, B6, K, ascorbic, folic acid, Ca, P, Mg amino acids (Kabak and Dobson 2011; Melo and Silva 2014)	LAB, acetic acid bacteria, other bacteria, yeasts, probably moulds (Lopitz-Otsoa, Rementeria et al. 2006; Robinson R K 2006; Magalhães, Pereira et al. 2010; Özdestan and Üren 2010; Tamang 2010; Tamang and Kailasapathy 2010; Tamang and Samuel	Potentially probiotic product (Lopitz-Otsoa, Rementeria et al. 2006; Magalhães, Pereira et al. 2010; Özdestan and Üren 2010; Tamang and Kailasapathy 2010; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Melo and Silva	Originated: Caucasus mountains (Lopitz-Otsoa, Rementeria et al. 2006; Özdestan and Üren 2010; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014) Consumed: Eastern Europe (Balcan-Caucasian region and Russia) (Steinkraus	Homemade and Industrialized (Lopitz-Otsoa, Rementeria et al. 2006; Chandan 2013)

	al. 2013; Marsh, Hill et al. 2014)	et al. 2006; Özdestan and Üren 2010; Tamang 2010; Tamang and Kailasapathy 2010; Tamang and Samuel 2010; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Chandan 2013; Madhu 2013)		2011; Altay, Karbancıoglu-Güler et al. 2013; Chandan 2013)	(Özdestan and Üren 2010; Tamang 2010; Kabak and Dobson 2011). antimicrobial activity (Tamang and Kailasapathy 2010; Altay, Karbancıoglu-Güler et al. 2013). reduction of symptoms of lactose intolerance and antitumor		2010; Altay, Karbancıoglu-Güler et al. 2013; Chandan 2013; Madhu 2013; Marsh, Hill et al. 2014; Melo and Silva 2014; Wolfe and Dutton 2015)	2014)	2002; Özdestan and Üren 2010; Tamang 2010; Tamang and Kailasapathy 2010; Chandan 2013; Marsh, Hill et al. 2014) Soviet countries (Tamang 2010).	

					activity (Tamang and Kailasapathy 2010)					
Ayran	Milk (cow or other type) (Marsh, Hill et al. 2014)	Low viscosity (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013)	Non-alcoholic (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013)	Lactic acid (Altay, Karbancıoglu-Güler et al. 2013)	Drinkable fermented milk, easily digestible, consumed mainly during summer months (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013)	Total dry matter (1.07–11%), protein (1.44–3.48%), salt (0.17–1.75%) and fat (0.1–3%) and high content of vitamins and calcium (Altay, Karbancıoglu-Güler et al. 2013)	LAB (Marsh, Hill et al. 2014)		Turkey (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014), Cyprus (Chandan 2013), Greece, Albania, Bulgaria, Fyrom (Chandan 2013)	Homemade and industrialized (Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013)

Buttermilk or **clabbered milk**	Usually cow milk, less often from buffalo milk (Tamang 2010; Panesar 2011)	Fluid with very low viscosity (Robinson R K 2006), acidic, sour taste (Tamang 2010) , slightly yellowish colour (Robinson R K 2006)			Health drink (Robinson R K 2006; Tamang 2010), particular in summer (Robinson R K 2006), may be used in cooking the same way as sour cream (Robinson R K 2006)		LAB (Tamang 2010)		Russia, Bulgaria (*Urgutnik* from sheep milk), Ireland (*Clabber*, from sheep milk), southern Scandinavia (Filland, *Kirnupiima* from sheep milk) and Hungary (*Savanyutez* from sheep milk) (Robinson R K 2006; Young WP 2006; Tamang 2010)	Homemade (Robinson R K 2006)
Bulgarian or **bulgaricus buttermilk** or **Bulgarian milk**	Boiled goat or cow milk (Tamang 2010; Tamang and	Acidic, sour due to high acidity, definitely impalatable			Sour milk, a type of cultured buttermilk, a drink		LAB (Farnworth 2008; Tamang 2010; Tamang and		Originated: Bulgaria (500 A.D.) (Farnworth 2008; Tamang	Homemade and industrialized

(Leatherman and Wilster 1944; Farnworth 2008; Tamang and Samuel 2010)	Samuel 2010; Panesar 2011)	(Leatherman and Wilster 1944; Tamang 2010)			(Farnworth 2008; Tamang 2010; Tamang and Kailasapathy 2010)		Kailasapathy 2010; Panesar 2011)		and Samuel 2010) Consumed: Yugoslavia, Greece, Turkey (Tamang and Samuel 2010), Albania, Romania (Tamang 2010)	
Acidophilus milk	Cow milk (Tamang 2010; Panesar 2011; Shiby and Mishra 2013)	Strong acid flavour, sour taste, viscous (Tamang 2010; Tamang and Kailasapathy 2010)			Traditional, medium acid type fermented beverage or drink (Tamang 2010; Shiby and Mishra 2013) poor table beverage due to its strong acid		LAB (Tamang 2010; Tamang and Kailasapathy 2010; Panesar 2011)	One of the first probiotic milk derived by Metchnikoff's observation (Tamang and Kailasapathy 2010)	Russia (Chandan 2013), East Europe, Greece, Turkey, Scandinavia (Tamang 2010)	Homemade and industrialized

					flavor (Tamang and Kailasapathy 2010), cultured milk (Leatherman and Wilster 1944)					
Sour milk	Sheep, cow, buffalo milk				Non-cultured fermented milk (Robinson R K 2006)		LAB (Robinson R K 2006)		Iceland , Denmark, Southern Norway and the remaining parts of Sweden (Robinson R K 2006) Kisela varenika (Bosnia) (Young WP	Homemade and industrialized

									2006) Snezhanka (Bulgaria) Dickmilch (Germany) (Young WP 2006) Oxygala (Romania) (Young WP 2006)	
Tätmjölk	Whole or skimmed milk (Robinson R K 2006)	Extremely viscous in texture, very mild acid taste and low syneresis (Robinson R K 2006)		Lactic acid, ethanol, carbon dioxide (Robinson R K 2006)	Fermented milk product (Tamang and Kailasapathy 2010)		Mesophilic lactic starter cultures (eg. Lactococcus spp. and EPS (exopolysaccharides)-producing Leuconostoc		In most of Norway and the nothern parts of Sweden southern and western Finland (Robinson R K 2006)	Homemade

							spp.) (Robinson R K 2006)			
Surmjölk	Whole or skimmed milk (Robinson R K 2006)	Mild acidic taste, but more flavour than Tätmjölk, viscous texture (Robinson R K 2006)			Traditional fermented milk, similar to Tätmjölk (Robinson R K 2006)		Similar to those present in Tätmjölk, but using non-EPS producing micro-organisms (Robinson R K 2006)		Sweden (Robinson R K 2006)	Homemade (Robinson R K 2006)
Skyr (Robinson R K 2006)	Ewes' milk (Robinson R K 2006; Farnworth 2008)	Rich and mild flavour due to lactic acid, acetic acid, diacetyl, acetaldehyde and ethanol		Lactic acid, acetic acid, diacetyl, acetaldehyde and ethanol (Chandan 2013)	Yoghurt or yoghurt-like milk product (Robinson R K 2006; Chandan 2013)		LAB, yeast and moulds (Robinson R K 2006)		Iceland (Robinson R K 2006; Farnworth 2008; Chandan 2013)	Homemade and Industrialized

		(Robinson R K 2006; Chandan 2013), is still flavoured by Icelanderers (Robinson R K 2006) ,concentrated texture(Robinson R K 2006)								
Filbunke (Robinson R K 2006)	Whole milk (Robinson R K 2006)	Gel texture (Robinson R K 2006)			Traditional fermented milk and variant product of either Tätmjölk and Surmjölk (Robinson R K 2006; Kahala,		Without EPS (exopolysaccharides) strains (Robinson R K 2006)		Finland (Robinson R K 2006; Kahala, Mäki et al. 2008; Tamang 2010; Tamang and Kailasapathy 2010; Chandan 2013)	Homemade until 1950, nowadays very limited (Robinson R K 2006)

					Mäki et al. 2008)					
Keldermilk	Milk (Chandan 2013)				Cultured milk (Chandan 2013)				Scandinavia (Chandan 2013)	Homemade
Taette or Lapp's milk(Farnworth 2008)	Cow milk (Muehlhoff, Bennett et al. 2013)				Viscous fermented milk, also known as cellarmilk (Farnworth 2008)		LAB		Norway (Farnworth 2008)	Homemade
Prokish	Sheep milk (Tamang and Samuel 2010)				Sour milk which later became yoghurt (Tamang and Samuel 2010)				Thrace (Greece) (Tamang and Samuel 2010)	Homemade
Laban	Animal milk (Tamang	Acidic, viscous			Yoghurt – like ,		LAB, yeasts (Tamang		Turkey	Homemade and industrialized

	2010)	(Tamang 2010)			served as a cool drink (Tamang 2010)		2010)		(Tamang 2010)	
Prostokvasha (Young WP 2006; Farnworth 2008)	Sheep's milk				Sour milk (Farnworth 2008)		LAB (Farnworth 2008)		Soviet Union (Farnworth 2008)	Homemade
Lyntyca (Young WP 2006)	Sheep milk (Young WP 2006)				Whey-based fermented beverage				Poland (Young WP 2006)	Homemade and industrialized
Žinčica (in Slovak)	Sheep milk (Young WP 2006)				Whey-based fermented beverage , Kefir- like beverage (Young WP 2006)				Czechoslovakia, Poland (Young WP 2006) *Žinčice* *Żentyca*	Homemade and industrialized

Table 7. Examples of traditional cereal-based NAFB consumed in European countries.

Name	Substrate	Sensory property and nature	Alcoholic content	Other metabolites	Nature of use	Nutrition data	Microbiota of fermentation	Functional properties	Country of consumption in Europe	Status of fermentation (homemade/ industrialized)
Boza (millet ale) (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013)	Wheat or rice semolina or a combination of rye, oat, barley, and millet flour, maize (Gotcheva, Pandiella et al. 2001; Arici and Daglioglu 2002; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Yeğin and Üren 2008; Kabak	Viscous liquid, colloid suspension, slightly sour or sweet flavour, acidic-alcoholic odor, pale yellow or from light to dark beige in color (Gotcheva, Pandiella et al. 2001; Arici and Daglioglu	Non- or low alcoholic: up to 1.5 % (Gotcheva, Pandiella et al. 2001; Kabak and Dobson 2011; Altay, Karbancıo glu-Güler et al. 2013; Muehlhoff, Bennett et al. 2013)	Lactic acid , ethanol, vitamins, antimicobial s (Arici and Daglioglu 2002; Yeğin and Üren 2008; Marsh, Hill et al. 2014), biogenic amines like tyramine(Ye ğin and Üren 2008)	Healthy and popular beverage for all ages, high nutritional value (Gotcheva, Pandiella et al. 2001; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Todorov, Botes et al. 2008;	Protein, carbohydra te, lactic acid, fibre and vitamins such as thiamine, riboflavin, pyridoxine and nicotinami de (Arici and Daglioglu 2002; Kabak and Dobson 2011)	LAB, yeasts (Gotcheva, Pandiella et al. 2001; Arici and Daglioglu 2002; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Todorov, Botes et al. 2008; Yeğin and Üren 2008; Kabak and Dobson 2011; Altay, Karbancıoglu-	Strain ST284BZ is the best probiotic (Todorov, Botes et al. 2008), rich source of probiotic bacteria, probiotic properties of L. plantarum, L. paracasei etc.(Altay, Karbancıoglu-Güler et al. 2013)	Turkey, Bulgaria, Albania, Romania, south Russia, Fyrom (Gotcheva, Pandiella et al. 2001; Arici and Daglioglu 2002; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Todorov, Botes et al. 2008; Yeğin	Homemade and industrialized (Yeğin and Üren 2008; Marsh, Hill et al. 2014)

	and Dobson 2011; Albuquerque, Costa et al. 2013; Altay, Karbancıoglu-Güler et al. 2013; Marsh, Hill et al. 2014)	2002; Blandino, Al-Aseeri et al. 2003; Prado, Parada et al. 2008; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013; Costa, Albuquerque et al. 2013; Muehlhoff, Bennett et al. 2013)			Yeğin and Üren 2008; Kabak and Dobson 2011; Altay, Karbancıoglu-Güler et al. 2013), consumed mainly in the cold winter nights (Kabak and Dobson 2011) ,on a daily basis (Balcan countries)(Todorov, Botes et al. 2008) is		Güler et al. 2013; Marsh, Hill et al. 2014)		and Üren 2008; Kabak and Dobson 2011; Albuquerque, Costa et al. 2013; Altay, Karbancıoglu-Güler et al. 2013)	

					regarded as the origin of ‘’beer’’(Arici and Daglioglu 2002)					
Kvass	Rye and barley malt, rye flour and stale rye (traditionally) (Dlusskaya, Jänsch et al. 2008)	Sparkling, sweet or sour, rye bread flavour (Marsh, Hill et al. 2014), golden-brown color(National Centre for Biotechnology Education 2002; Dlusskaya, Jänsch et al. 2008; Sõukand,	Non- or low-alcoholic: 1% or less (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014)	Lactic acid, acetic acid, ethanol, vitamins, minerals (Dlusskaya, Jänsch et al. 2008)	Popular beverage (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014)	Carbohydrates (mainly maltose, maltotriose, glucose and fructose), proteins and aminoacids, vitamins(Dlusskaya, Jänsch et al. 2008)	LAB and yeast (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014)		Countries of former Soviet Union, especially Russia (National Centre for Biotechnology Education 2002; Dlusskaya, Jänsch et al. 2008; Albuquerque, Costa et al. 2013; Marsh, Hill et al. 2014; Sõukand,	Industrialized (Dlusskaya, Jänsch et al. 2008; Marsh, Hill et al. 2014; Sõukand, Pieroni et al. 2015), homemade (very rare) (Sõukand, Pieroni et al. 2015)

		Pieroni et al. 2015)							Pieroni et al. 2015) In the past in eastern Poland (Sõukand, Pieroni et al. 2015)	
Hulumur	Sorghum, rice, millet (Tamang 2010)	Mildly acidic (Tamang 2010)			Drink (Tamang 2010)		LAB (Tamang 2010)		Turkey (Tamang 2010)	Homemade
Kaera, kiesa or **kaerapiim** **(**Sõukand, Pieroni et al. 2015)	Oat seeds				Sour liquor, drunk on the side of the meal (Sõukand, Pieroni et al. 2015)				Esthoni (Sõukand, Pieroni et al. 2015)	Homemade
Kile (Sõukand, Pieroni et al.	Oat flour mixed with water	Sour taste (Sõukand, Pieroni et al.			Filtered beverage, consumed instead of				Esthonia (Sõukand, Pieroni et al.	Homemade

2015)		2015)			sour milk on the side of the meal (Sõukand, Pieroni et al. 2015)				2015)	
Borș (*Borsh)*	Rye or wheat bran (Sõukand, Pieroni et al. 2015)	Sour taste (Sõukand, Pieroni et al. 2015)			Light summer beverage (Sõukand, Pieroni et al. 2015)				Hungary and Hungarians living in other surrounding countries (eg. Romania) (Sõukand, Pieroni et al. 2015)	Homemade
Taar	Rye and barley, rarely also oats (Sõukand, Pieroni et al. 2015)	Sour taste (Sõukand, Pieroni et al. 2015), may be flavoured with juniper ‘’fruits’’ (galbula)			Drink (Sõukand, Pieroni et al. 2015)				Esthonia (Sõukand, Pieroni et al. 2015)	Homemade

		(Sõukand, Pieroni et al. 2015)								
Kali	Malted cereals (Sõukand, Pieroni et al. 2015)				Similar to kvass (Sõukand, Pieroni et al. 2015)				Esthonia (Sõukand, Pieroni et al. 2015)	Homemade

Table 8. Examples of traditional fruit-based NAFB consumed in European countries.

Name	Substrate	Sensory property and nature	Alcoholic content	Other metabolites	Nature of use	Nutrition data	Microbiota of fermentation	Functional properties	Country of consumption in Europe	Status of fermentation (homemade/ industrialized)
Hardaliye	Red grape juice and pomace (Arici and Coskun 2001; Coskun and Arici 2006; Kabak and Dobson 2011; Aydoğdu, Yıldrırm et al. 2014)	The original color of the grapes, acidic (Coskun and Arici 2006; Güven and Aksoy 2009; Aydoğdu, Yıldrırm et al. 2014)	Non-alcoholic ,0,28-0,59% (Kabak and Dobson 2011)		Traditional non-dairy probiotic beverage, antioxidant properties (Arici and Coskun 2001)	Antioxidants (Arici and Coskun 2001)	LAB, uncharacterized fungal component (Arici and Coskun 2001)		Origin: Thrace in the Marmara region of Turkey Consumed: Thrace region of Turkey (Arici and Coskun 2001; Aydoğdu, Yıldrırm et al. 2014)	Homemade, small scale local technologies (Arici and Coskun 2001)
Gilaburu juice	Cranberrybush (Viburnum opulus L.) (Yilmaztekin and	Astringent without the addition of sugar	Non-alcoholic (Yilmaztekin and	Acetic acid (Yilmaztekin and Sislioglu 2015)	Traditional ,may be a health promoting beverage(		LAB	Possible probiotic potential	Regions in Central Anatolia of Turkey,	Homemade

	Sislioglu 2015)		Sislioglu 2015)		Yilmaztekin and Sislioglu 2015)				Kayseri (Soylak M 2002)	
Juniper beer (called psiwo kozicowe or piwo jałowcowe in Poland) (Madej, Piroznikow et al. 2014)	Juniper berries (Juniperus communis L., Cupressaceae (Sõukand, Pieroni et al. 2015)	Sweet and sour taste (Madej, Pirozniko w et al. 2014)	Low (Madej, Pirozniko w et al. 2014)		Traditionally served at weddings (Madej, Pirozniko w et al. 2014), baptisms, and funeral parties (Chętnik 1936), nowadays sold at folklore events, village fetes, culinary festivals				Northern Poland Similar drinks: countries in the Baltic Sea (e.g. Estonia, Finland, Sweden) (Madej, Piroznikow et al. 2014; Sõukand, Pieroni et al. 2015)	Homemade, not mass produced, sold upon request (Madej, Piroznikow et al. 2014)

					(Madej, Pirozniko w et al. 2014)					
Wild apple and cherry vinegars	Fruits of wild apple(Malus sylvestris) and Cornelian cherry trees (Cornus mas) (Sõukand, Pieroni et al. 2015)				Health properties (Sõukand, Pieroni et al. 2015), drunk as a preventive beverage (Sõukand, Pieroni et al. 2015), anti-obesity product and externally against bruises, fever and headache (Pieroni,				Istro-Romanians in Croatia (Pieroni, Giusti et al. 2003), South Kosovo, NE Albania, Hungary (Sõukand, Pieroni et al. 2015)	Homemade (Sõukand, Pieroni et al. 2015)

					Giusti et al. 2003; Quave and Pieroni 2014)					
Beverage from fruit pickles	Wild apples, pears, plums, blackberries (Rubus caesius), raspberries (Rubus idaeus), lingonberries (Vacciniumvitis-idaea), medlars (Mespilus germanica) (Sõukand, Pieroni et al. 2015)	Acidic taste (Sõukand, Pieroni et al. 2015)				Valuable source of vitamins during the winter months (Sõukand, Pieroni et al. 2015)			Devin area(South Bulgaria, Rhodopes Mts.) (Sõukand, Pieroni et al. 2015)	Homemade
Fermented fruit and roots	Fruits or roots from wild Cornelian cherries, gentian roots (Gentiana lutea), sloe (Prunus	Carbonated, sour, sweet (Quave and Pieroni	Low or non-alcoholic (Quave and Pieroni 2014)		Perceived "health" benefits (such as flu-remedy,		LAB (Quave and Pieroni 2014)		Slavic Gorani minority living in NE Albania and South Kosovo (Quave and	Homemade

	spinose), wildapples, juniper berries (Juniperus communis), cultivated apples, plums, damsons, cherry-plums (Prunus cerasifera) (Quave and Pieroni 2014)	2014)			diarrhea remedy, hypertension remedy), "good for the heart", nutritious, potable, culturally appropriate (Islamic faith) (Quave and Pieroni 2014)				Pieroni 2014)	

Table 9. Examples of traditional vegetable-based NAFB consumed in European countries.

Name	Substrate	Sensory property and nature	Alcoholic content	Other Metabolites	Nutrition data	Nature of use	Microbiota of fermentation	Country of consumption in Europe	Status of fermentation (homemade/ industrialized)
Sauerkraut juice or Kraut juice	Cabbage, especially white cabbage (Karovičová and Kohajdová 2003; Lugasi and HóVÁRI 2003)			Lactic acid, acetic acid, biogenic amines (Karovičová and Kohajdová 2003)		Lactic-acid fermented beverage, claims that it helps digestion and normal function of the intestinal tract and the stomach, antimicrobial properties, health and nutritional benefits (Karovičová and Kohajdová 2003)	LAB (Karovičová and Kohajdová 2003)	German (*Sauerkrautsaft***)** Ukrain (Odessa) Romania (*Moare*) Serbian (*Rasol*) (Karovičová and Kohajdová 2003)	Homemade and industrialized (Karovičová and Kohajdová 2003; Lugasi and HóVÁRI 2003)
Şalgam or Şalgam juice	Black (purple) carrot (Daucus carota), turnip (Brassica	Red-colored, cloudy, sour (Erten, Tanguler et al. 2008)	Non-alcoholic: 0.1-0.641% (Erten, Tanguler et al. 2008; İncedayi,		Vitamins (A, C, and B group vitamins) , minerals (calcium, potassium, and	Lactic-acid fermented beverage, soft drink, widely consumed with food (Tanguler and Erten 2012)	LAB, yeasts (Arici 2004; Baysal, Çam et al. 2007; Tanguler and Erten 2012)	Origin: Cukurova province of Turkey Consumed: All over Turkey (Adana, Hatay and Icel -the	Homemade, commercially on a small scale (Erten, Tanguler et al. 2008)

	rapa) (Turker, Aksay et al. 2004)		Uylaşer et al. 2008)		iron) (Baysal, Çam et al. 2007), amino acid and polyphenol content (Erten, Tanguler et al. 2008; İncedayi, Uylaşer et al. 2008)			Medditeranean region of Turkey) Popular in metropolises such as Istanbul, Ankara and Izmir (Tanguler and Erten 2012)	
Turshiena chorba	Hot peppers or horseradish roots (Sõukand, Pieroni et al. 2015)	Salty, pungent, spicy and acidic (Sõukand, Pieroni et al. 2015)				Healthy for conditions like gastritis and ulcers, especially during the winter (Sõukand, Pieroni et al. 2015)	Lactic acid fermentation (Nedelcheva 2013)	Bulgaria (Nedelcheva 2013)	Homemade (Nedelcheva 2013)

Table 10. Examples of traditional herbs, spices and aromatic plant-based NAFB consumed in European countries.

Name	Substrate	Sensory property and nature	Alcoholic content	Other Metabolites	Nature of use	Microbiota of fermentation	Country of consumption in Europe	Status of fermentation (homemade/ industrialised)
Kombucha	Sweetened tea (black or green, but best black) (Reiss 1994; Cvetković, Markov et al. 2008; Tamang and Kailasapathy 2010; Nguyen, Dong et al. 2015)	Slightly sweet, carbonated, acidic (Cvetković, Markov et al. 2008; Tamang and Kailasapathy 2010), tasting like sparkling apple cider(Dufresne and Farnworth 2000)	Low (Blanc 1996)	Mainly acetic acid (Cvetković, Markov et al. 2008; Nguyen, Dong et al. 2015), gluconic and glu- curonic acids, ethanol, glycerol (Blanc 1996; Liu, Hsu et al. 1996)	Health (Dufresne and Farnworth 2000) and antimicrobial properties (Tamang and Kailasapathy 2010; Marsh, Hill et al. 2014)	LAB, acetic acid bacteria, yeasts (Greenwalt, Steinkraus et al. 2000; Tamang and Kailasapathy 2010; Marsh, Hill et al. 2014; Nguyen, Dong et al. 2015)	Origin: China Consumed: worldwide (Blanc 1996; Cvetković, Markov et al. 2008; Marsh, Hill et al. 2014)	Homemade, (Dufresne and Farnworth 2000), industrialized (Cvetković, Markov et al. 2008)
Mursalski chai (mursal tea)	Sideritis Scardica Griseb (Albuquerque, Costa et al. 2013;				Tea drink (Costa, Albuquerque et al. 2013), medicinal		Bulgaria (Smolian, Devin) (Albuquerque, Costa et al. 2013;	Industrialized

	Costa, Albuquerque et al. 2013)				tea (Chendey, Rishko et al. ; Hollands, Saha et al. 2013)		Costa, Albuquerque et al. 2013; Danesi, Pasini et al. 2013) and FYROM (Hollands, Saha et al. 2013)	
Socata (Elderberry soft drink)	Flowers of elderberry (Sambucus nigra L.) (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013)		Low or non-alcoholic (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013)		Soft drink (Costa, Albuquerque et al. 2013)	Sambucus nigra L., yeasts (Albuquerque, Costa et al. 2013)	Romania (Transylvania) (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013; Danesi, Pasini et al. 2013)	Homemade (Costa, Albuquerque et al. 2013)
Çay (Black tea)	Leaves of Camelia sinensis (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013)						Turkey (Black Sea, coastal area) (Albuquerque, Costa et al. 2013; Costa, Albuquerque et al. 2013; Danesi,	Homemade, industrialized

							Pasini et al. 2013)	
Ginger beer	Ginger (National Centre for Biotechnology Education 2002; Madden 2008)	Acidic taste, sparkling (Madden 2008)	Low (Kiple and Kriemhild Coneè Ornelas 2000; Madden 2008)		Healthy, carbonated soft drink, counterirritant, easily digested, popular among children (Smith 2004; Unknown 2015)	LAB and yeasts (Dookeran, Baccus-Taylor et al. 2004; Osuntogun and Aboaba 2004)	Origin: England (Kiple and Kriemhild Coneè Ornelas 2000; National Centre for Biotechnology Education 2002; Madden 2008) Consumed: Worldwide	Homemade (past), commercial (Kiple and Kriemhild Coneè Ornelas 2000; National Centre for Biotechnology Education 2002; Smith 2004; Madden 2008)
Birch beer	Sap of birch trees (usually sweet or black birch) (Encyclopædia Britannica ; WHITING 1909; Helfferich 2003; Smith 2007)	Less sweet and carbonated than root beer (Helfferich 2003; Smith 2007)	Non-alcoholic (Helfferich 2003; Smith 2007)		"Family" drink, health promoting (Smith 2007), healing properties (Svanberg, Sõukand et al. 2012)		Mostly Scandinavia, East Europe (Russia, Lithuania, Ukraine) (Helfferich 2003; Svanberg, Sõukand et al. 2012)	Homemade (past), commercial (Smith 2007)
Root beer	Various roots (eg. hops, burdock, sarsaparilla)	Sweet taste, flavoured with a mixture of herbal	Low (Unknown 2015)		Sweet soft drink, health beverage in centuries past	Yeasts (Smith 2004)	England (National Centre for Biotechnology	Homemade (past), commercial (National Centre

	(Fountain 1915; Brown 1966)	essences (Smith 2004)			(Smith 2004; Unknown 2015)		Education 2002)	for Biotechnology Education 2002; Unknown 2015)
Fermented tree saps	Birch (Betula pendula, B. pubescens) (Svanberg, Sõukand et al. 2012; Sõukand, Pieroni et al. 2015)		Low (Sõukand, Pieroni et al. 2015)		Hay-time drink ,usually consumed in the summer (Svanberg, Sõukand et al. 2012; Sõukand, Pieroni et al. 2015)		Russia, Belarus, Ukraine, Estonia, Poland (Sõukand, Pieroni et al. 2015), Hungary (Sõukand, Pieroni et al. 2015) Scandinavia (especially in Sweden)(Svanberg, Sõukand et al. 2012)	Homemade

Table 11. Examples of commercially available functional NAFB in European countries (Maukonen, Alakomi et al. 2006; Özer and Kirmaci 2010; Perricone, Bevilacqua et al. 2014).

Product	**Substrate**	**Producer, Country**	**Functional culture**
Acidophilus milk	Milk	Sweden, several countries	*Lb. acidophilus*
Acidophilin	Milk	Probiotic, Russia	*Lb. acidophilus, Lc. lactis subsp. lactis, Kefir culture*
Diphilus milk	Milk	France	*Lb. acidophilus, B. bifidum*
Biomild	Milk	Germany	*Lb. acidophilus, B. bifidum*
AB milk products	Milk	Denmark	*Lb. acidophilus, Bifidobacteria*
Bifighurt	Milk	Germany	*B.longum (CKL 1969) or B. longum (DSM 2054)*
Bifilak©t	Milk	USSR	*Lb. acidophilus, Bifidobacteria*
Biokys (=Femilact)	Milk	Chechoslovakia	*Lb. acidophilus, Bifidobacteria and Pediococcus acidilactici*
Acidophilus yeast milk	Milk	Russia (former USSR), western European countries (a very limited volume)	*Lb. acidophilus, lactose fermenting yeasts (Saccharomyces cerevisiae, Saccharomyces boulardii)*
Bifidus milk	Milk	Germany	*B. bifidum or B. longum*
Arla A-38 (A-38 fermented milk)	Milk	Denmark	*Lb. acidophilus, Bifidobacterium bifidum, Leuconostoc mesenteroides ssp. cremoris, mesophilic lactococci*

AKTFIT plus	Milk	Switzerland	*Lb. acidophilus, Bifidobacteria, Lb.casei GG and S. thermophilus*
Verum ® (Filmjölk variant)	Milk	Essum AB, Sweden	*Lactococcus lactis* L1A, *Lactobacillus rhamnosus* LB21
Gaio®	Milk	MD Foods, Denmark	*Enterococcus faecium*, *Streptococcus thermophilus*
Actimel®	Milk	Danone, France	*Lb. casei* Immunitas ™
Vifit Drink®	Milk	Mona, The Netherlands	*Lb. casei* GG, *Lb. acidophilus*, *Bifidobacterium bifidum*
CHAMYTO®	Milk	Nestle, France	*Lb johnsonii*, *Lb. helveticus*
Cultura®	Milk	Arla Foods, Sweden	*Lb. acidophilus*, *B. bifidum*
ProCult Drink®	Milk	Müller, Germany	*B. longum* BB536, *S. thermophilus*, *Lb. delbrueckii* subsp. *bulgaricus*
Gefilus ® (fermented whey drink, Fermented milk, fruit drink, Drinking yoghurt)	Milk	Valio Ltd., Finland	*Lb. rhamnosus* GG Vitamins C and D
Proviva ®	Cereal (oat)	Skane Dairy, Sweden	*Lb. plantarum* 299v
Evolus®	Milk and fruit	Valio Ltd., Finland	Bioactive peptides
Flora Pro-Activ	Milk	Unilever, UK	Phytosterol

Zen	Milk	Danone Belgium	Magnesium
Milone	Milk whey	Poland	Whey and kefir bacteria
Serwovit	Milk whey	Poland	Whey

The results of the 1rd study have been accepted for publication in the form original work in the journal Nutrition Research Reviews [Baschali A, Tsakalidou E, Kyriacou A, Karavasiloglou N, Matalas AL. Traditional low-alcoholic and non-alcoholic fermented beverages consumed in European countries: a neglected food group. Nutr Res Rev 2017 Jun;30(1):1-24. doi: 10.1017/S0954422416000202. Epub 2017 Jan 24]

CHAPTER 4: STYDY II

The Comeback of Homemade Foods and the Role of the Web. The Case of Non-Alcoholic Fermented Beverages

4.1 Introduction

A growing interest in the preparation and consumption of homemade foods is currently being observed among people in urban centers. Homemade foods have a special role in the construction of family identities (Moisio / Arnould / Price 2004, p. DOI: 10.1177/1469540504046523) mainly through their importance in contemporary consumption and their opposition to the market's attempts to commodify the homemade food category. Furthermore, citizens expect that these foods are of improved quality and offer benefits in the areas of nutrition, health and finance. (Hispanic Business.com, 2013) In contrast to industrially processed foods, homemade foods are more often based on all-natural ingredients, involve better cooking methods (American Heart Association 2014[a]) and avoid substitutions by unhealthy ingredients (American Heart Association 2014[b]). Nowadays, with the economy in recession, people prefer homemade food, since they believe that they are superior than fast food or pre-cooked meals, from an economic perspective (*New York Times* 2011)

Eating homemade food also provides health benefits. It enables appropriate portion sizes to be maintained and makes it possible for people to avoid the urge to indulge in oversized restaurant meals. Recent research has found that families, who consume more fast-food meals than home-cooked ones, are less likely to eat fruit and vegetables, and had an overall increase in consumption of salty snacks and soda (Boutelle et al. 2007, pp. 16-23). Homemade food also helps people, especially children and teenagers, to adopt healthy eating habits.

A great variety of fermented solid and liquid foods can be produced naturally from the fermentation of raw foodstuffs by indigenous microorganisms or by adding microorganisms (starter cultures) to them (Tamang / Kailasapathy 2010). The preparation and consumption of fermented beverages in particular, has a long tradition all over the globe. Because there is practically an endless diversity of fermentable substrates, the variety of the beverages traditionally produced is remarkable. In western societies, beverages made with alcohol-producing yeasts, such as beers and wines, are the dominant ones. But fermentation need not always result in a beverage with alcoholic content. Preparation of sour or acidic non-alcoholic beverages may be characteristic of religious groups that forbid consumption of beverages

produced through an alcohol-producing fermentation procedure. These non-alcoholic fermented beverages have generally received rather little attention, from consumers or from scientists.

The Web has emerged as a social and cultural phenomenon with a very substantial impact on communication (Beck et al. 2014, p. 28), as it enables people to publish their thoughts and to participate in a global dialogue. The information on the Internet is exchanged in real time and in a way that has, until recently, been impossible to achieve in real life for most people. Networks allow tens of thousands of specific groups of people to perform a series of social, professional and educational activities in places where they work or live, or in other locations. A recent addition to online media relates to healthy eating and healthy food choices, and several websites, blogs and forums now focus on these themes (Valente 2010)

The objective of the content analysis study carried out by the authors and dealt with in this paper was to evaluate information on traditional non-alcoholic fermented beverages available on the Web, as to date there has been lack of studies exploring issues of this kind. Thus, an examination of information on websites, blogs and forums about this topic, to which users may be exposed, was conducted. We applied an extensive first- and second-generation sampling methodology and a well-developed and detailed coding manual. As a result, a valid depiction of what visitors to homemade non-alcoholic fermented beverages webpages may encounter in digital space, was produced.

4.2 Methods

4.2.1 Study sample

In order to obtain a valid and representative sample for a systematic content analysis, we first established a population of sites, blogs and forums in the English language using Yahoo and Google search engines dealing with our topic. We selected the top twenty (20) websites, blogs and forums with the highest PageRank of Google PageRank (Google PR), which is one of the methods used to determine a page's relevance or importance (second level of inclusion criteria) for a given topic.

Selected websites and blogs were visited by the authors of this paper on a regular basis during a 6-month period and their content with regard to types of homemade non-alcoholic fermented beverages, preparation methods, cultural aspects, ways of promotion, and messages regarding their health effects, were recorded and evaluated. Almost all the websites, blogs and forums examined were available in the public domain and only 20% (n=4) required approval from a

maintainer for the exclusive entry to certain pages. In these cases, we collected data from only the publicly available portions.

4.2.2. Variables and features of websites, blogs and forums

Before coding the sample of 20 websites, blogs and forums, we reviewed the existing literature and proposed variables for our analysis. Variables were pilot tested on a random sample of 10 sites. This testing was conducted in order to streamline the number of variables considered; we removed many variables from consideration because they were not providing new information.

In the interest of standardizing techniques across sites with varying amounts of content, approximately 10 minutes were spent searching for each variable on any site, blog or forum. For each of them we coded 15 variables. Most variables were objective and easy to code; however, the constructs for the features of each variable were more subjective in that we combined information from the existing literature and from a pilot study on a random sample of 10 sites.

4.2.3 Statistical Analysis

Our analysis was straightforward and primarily descriptive and all the variables were categorical. In this study, quantitative research methods (frequencies) were used in order to investigate the profile of the sites, blogs and forums available on the Web, which contained information on non-alcoholic fermented beverages. We used SPSS13.0 software for Windows (SPSS Inc, Chicago, IL) in conducting the analysis.

4.3 Results

In the following section, we first present information on the various features of the 20 websites, blogs and forums reviewed. Then, we present information from comments that visitors made regarding the non-alcoholic fermented beverages and which appeared on these websites, blogs or forums.

4.3.1. Site, blog, forum logistics

From the selected study sample (n=20), half (n=10, 50%) were websites, 45% (n=9) were blogs and 5% (n=1) were forums, with a mean grade of PageRank equal to 4. The majority of them

(n=19, 95%) had open-access information, and only 5% (n=1) required registration or subscription. Most of the sites, blogs and forums (n=12, 60%) held "free'' Web addresses and were hosted through another site; 40% (n=8) had purchased URLs.

Of the sites, blogs and forums visited, 20% (n=4) focused on home fermentation, 45% (n=9) had a substantial amount of Food and Drink or Cooking content, 15% (n=3) had nutritional content, 15% (n=3) endorsed focus on concerns addressed to the general public, 5% (n=1) centered on tourism, while none of them involved health-care topics (**Figure 5**). Only 5% (n=1) of the study sample promoted their content (information) in a written form; the majority (n=19, 95%) combined the written form with images, photos and videos. Approximately all of them (n=18, 90%) were lacking cited scientific literature.

Most of the study sample was interactive (n=19, 95%) and not static or to read only, that is, they allowed a community to form, in which users could post comments or communicate via an online forum or message board with named or anonymous posts. Regarding the way of communicating, most of the sites/forums (n=14, 70%) required no registration or subscription and only 30% (n=6) required registration or subscription.

Approximately 45% (n=9) of the study sample appeared to be maintained by an individual and 55% (n=11) by a group. Contact listing for site maintainers was provided on sixteen (16) of them; Ten (10) of them offered e-mail contact, five (5) provided telephone contact, five (5) provided postal contact via address, twelve (12) used an automatic system filling in a conduct form and finally four (4) offered other tools, such as discussion forums, live chat, and so on.

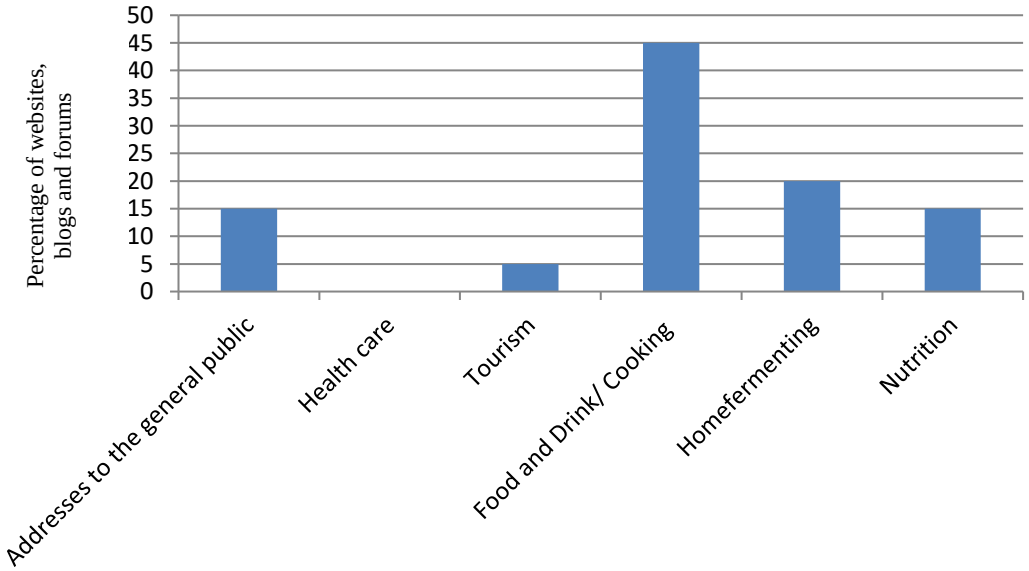


Figure 5. Percentages of websites, blogs and forums focus on different target groups.

Three quarters (n=15, 75%) of the study sample had a search engine and only 5% (n=5) did not offer any. Furthermore, most of them (n=17, 85%) shared information on search machines (19% on Google, 30% on Facebook, 26% on Twitter and 25% on others, such as Pinterest, Youtube and Pin it).

Only a minority of the sites, blogs and forums (n=3, 15%) were retailing fermented beverages or the main ingredients for their production. Most of them (n=18, 90%) contained advertisements for different products and only 10% (n=2) did not have a commercial character.

4.3.2 Visitors' Comments

From our research, we found 79 posts during a 6-month period in these 20 sites, blogs and forums related to various traditional homemade non-alcoholic fermented beverages originating from different parts of the world. To monitor and track visitors' concerns about these beverages, we gathered information from the comments or responses, which were contained in most of these 79 posts and which were written by visitors to these webpages.

Regarding health, consumers asked a lot of questions or statements about the health benefits of certain beverages, particularly concerning good digestion. Many of the comments were in fact questions, regarding particularly digestive issues, and statements involved providing information about the recommended portions of milk kefir for beginners and for children. Issues involving organoleptic characteristics, such as details on taste, flavor and texture of the beverages, were found on most of the posts. Practically, all comments had concerns about the methodology of preparation and preservation of these beverages.

Because these beverages are characterized as non-alcoholic, many of the viewers wished to clarify whether or not they contained even a small quantity of alcohol. A large proportion of the comments contained data (required or provided by the visitors) about health, nutrition and consumer information. Consumers also had concerns about home economics, especially about food waste and the cost of the final product. Furthermore, they wished to be informed about the total cost of these homemade beverages or the prices of commercial non-alcoholic fermented beverages. Another important issue involved recommendations about safety and hygiene. A great deal of discussion took place about different versions of recipes, substitutions for other foods, and other uses of these beverages.

Our research revealed that many consumers wished to give their opinion about beverages bought from certain web stores. In addition, they gave references or proposed certain sites, which

contained information about these beverages or which were retailing these products or their ingredients. Finally, they often recommended different brands or different names and recipes for the same beverage consumed in different countries or regions.

4.4 Discussion and Conclusions

Homemade, non-alcoholic fermented beverage webpages, blogs and forums often serve as a venue for expression where users can voice opinions or post traditional recipes, and they are thus an interactive resource with a range of information and features available to anyone with an Internet connection. From the analysis of the profile of the webpages, blogs and forums, we concluded that half of them were websites and that most of them were easy to access and understand, with only few requiring membership, and that the writing standard in half of them was less than high-school grade level.

Almost half of them had home fermentation content and it was noted that photos and videos of preparation methods were found on almost every webpage. The submission of suggestions about where to find the ingredients of these beverages, how to prepare them, or where to buy them, were very common. Furthermore, the majority of the sites, blogs and forums shared information about search machines or about other social networking websites, since social interaction is the most common reason why young people use the Internet. It is clear from our analysis that the population under study consists of dynamic communities with ever-changing, user-contributed content.

Content analysis, such as the one described, here provides systematic data on what is available and likely to be seen by users of homemade, non-alcoholic fermented beverage webpages, blogs and forums. In addition, we have provided a methodology to evaluate information available on the Web about these beverages. Different methodologies must be employed to determine whether and how exposure to such material and media affects users.

Our study showed that a substantial variety of traditional beverages, such as, homemade non-alcoholic fermented beverages, originating in different parts of the world, are included in the webpages that we studied. These results provide us with some insight into the variability, preparation methods, and the consumption rate of these beverages in the western world, where this group of fermented products has received to date little attention from the scientific community.

From the analysis of the comments of the visitors on the webpages, we concluded that the most common themes of concern were health issues, methodology of preparation and preservation, organoleptic characteristics of the beverages and nutrition related information. The most common questions regarding special age groups concerned digestive issues, safety and hygiene matters, portions for consumption, and the alcohol or caffeine content of the final product. In practically every message board there were questions involving the organoleptic characteristics of the final product and preparation and preservation methods. A large proportion of the comments concerned home economy and hosted many questions about food wasting and the cost of the final product (homemade or commercial). This was to be expected since almost half of the studied population was interested about home fermentation. However, the number of the posts, which contained visitors' comments, was limited, thus a larger number should be evaluated in order to present integrated findings.

Because technology is constantly advancing, these webpages, blogs and forums will evolve and change. Already, recent media report that sites now use more video and social networking approaches than formerly, and we can hypothesize that this interactivity will in fact increase. To better understand how messages with the potential for good or harm are communicated through such media venues, researchers must continue to investigate both the messages to which an individual is exposed and their impact.

The present study has certain limitations, which should be taken into account when interpreting the data. First, it should be kept in mind that websites are dynamic and sometimes short-lived. A return to the sampled sites might reveal new data. Although we visited these sites on a regular basis during a six-month period, some data may be lost, thus more regular monitoring may be needed.

Furthermore, the many different names, which were used for the same beverage according the country or even the region in which it was originated or was consumed, raised difficulties in distinguishing the different types of homemade non-alcoholic fermented beverages on all occasions. Thus, for these cases, and when the preparation method was not included in the information gathered, we tried, where possible, to integrate them into existing known beverage-types.

It should also be noted that approximately all of the websites, blogs and forums were lacking cited scientific literature. Also, as food blogs do not always provide sound information on nutritional issues, the public should be aware of the limitations of popular food blogs, and

dietitians could assist in modifying blog recipes for individuals to improve the nutritional profile of these recipes.

A final limitation concerns the subjectivity involved in an analysis such as ours. We did not have multiple researchers consider the data objectively and the selection of the variables, their features, and the content analysis of the sites may thus be biased. Although we believe that many of the sites examined had a more commercial character than an informative one, site maintainers or users might disagree with this evaluation.

The results of the 2nd study have been published in the form original work in the Proceedings of the 20th International Ethnological Food Research Conference [Aristea Baschali and Antonia-Leda Matalas (2015). The Comeback of Homemade Foods and the Role of the Web. The Case of Non-Alcoholic Fermented Beverages. 1st ed. In: Food and the Internet. Proceedings of the 20th International Ethnological Food Research Conference, pp.45-54, Violetta Krawczyk-Wasilewska/Patricia Lysaght (eds.) Peter Lang GmbH, Frankfurt am Main. Furthermore, the results of the 2nd study have been presented orally in the 20th International Ethnological Food Research Conference, Department of Folklore and Ethnology, Institute of Ethnology and Cultural Anthropology, University of Lodz, Poland, 3-6 September 2014.

CHAPTER 5: STYDY III

Understanding Consumers' Perceptions, Behavior and Attitudes Towards Homemade Non- Alcoholic Fermented Beverages in On-line Comments: A Content Analysis

5.1 Introduction

Although convenience food and beverages, constitute a large part of the food market globally, a growing interest in the preparation and consumption of homemade foods and beverages is currently being observed among people in urban centers (Rivera XCS, Orias NE, Azapagic A, 2014; Key Note, 2013). Homemade foods and beverages have a special role in the construction of family identities, mainly through their importance in contemporary consumption and their antagonism to the market's attempts to commodify the homemade food category (Moisio R. et al 2004). In contrast to industrially processed foods, such as chilled and frozen ready-made meals and sugar-sweetened beverages, homemade foods are more often prepared from wholesome ingredients; they require a limited use of additives and are usually prepared and consumed within a short period of time. Also, they give consumers the opportunity to experiment with new cooking methods and a variety of ingredients. (Boutelle KN et al, 2007). Consumption of commercial complementary food during infancy and childhood in particular, such as ready made milled vegetables/fruits, pasteurized flavoured milk, milk pudding, fruit juice etc., has been associated with increased sugar intake, while offering the homemade version was shown to reduce sugar intake (Foterek K, Buyken AE, Bolzenius K et al, 2016).

Food fermentation has a long tradition in practically every society around the world and fermented foods and beverages constitute an important part of cultural evolution and human nutrition with important contributions to food sustainability, security and transformation and preservation (Marshall E & Mejia D , 2011; Farnworth ER, 2008; Tamang JP & Samuel D, 2010). The diversity of fermented beverages produced, such as wine, beer and fermented milks, is the result of different raw materials, starter cultures and fermentation conditions and the variety of the beverages traditionally and industrially produced is remarkable (Steinkraus KH, 2002; Josephsen J, Jespersen L, Hui Y *et al.*,2004; Tamang J, 2010). In western societies, beverages made with alcohol-producing yeasts, such as beers and wines, are the dominant ones. But fermentation need not result in an alcoholic beverage.

Non-alcoholic fermented beverages (NAFB) refer to beverages produced via fermentation process and contain no alcohol (<0.5% alcoholic strength by volume, which is the number of

liters of ethanol contained in 100 liters of beverage both volumes being measured at a temperature of 20^0C) or small amounts of alcohol (<1.2% alcoholic strength by volume), respectively. These beverages constitute important part of culinary traditions and are important in achieving safety in traditional settings (Tamang JP & Samuel D, 2010; Fonden R, Leporanta K, Svensson U, 2006). In addition, a number of health benefits have been attributed to NAFB, albeit the fact that most of those have not been proven yet in an unequivocal manner (Baschali A et al., 2016). Many of these beverages contain a special category of starter or adjunct cultures, the so-called probiotic cultures, which are generally considered to be health promoting ingredients, since they have been shown to help in the treatment of gastrointestinal tract diseases, such as the prevention of antibiotic- and infectious-associated diarrhea, the alleviation of the symptoms of irritable bowel syndrome and lactose intolerance, the maintenance of the remission of ulcerative colitis and prevention of the relapse of Crohn's disease (Khani S, M Hosseini H, Taheri M *et al.*, 2012; Elmadfa I, Klein P, Meyer AL, 2010;Takano T, 2002).

NAFB differ in many ways from massively produced non- and low- alcoholic beverages currently consumed in modern societies, such as the sugar sweetened beverages. Due to the fermentation process, NAFB have unique sensorial properties and enhanced nutritional value (Baschali A et al, 2016; Mrdjenovic G & Levitsky DA, 2003; Harnack L et al 1999; O'Connor TM et al, 2006). Depending on the raw materials used, they are good sources of proteins, lipids or carbohydrates, as well as, of various vitamins, minerals and/or antioxidants. Milk-based fermented beverages in particular, apart from being a good source of milk -deprived of its lactose content, they also contain bioactive compounds, mainly immunoglobulins, bioactive peptides, hormones, cytokines, growth factors and probiotics (Baschali A et al, 2016). With respect to homemade NAFB, these are deemed to be even better, as they can be prepared using less sugar or salt compared to their commercial versions.

The Web has emerged as a social and cultural phenomenon with a very substantial impact on communication (Beck et al., 2014). It enables people to seek information, publish their thoughts and participate in a global dialogue. Healthy eating and healthy food choices are a theme on which many online media have recently focused (Valente, 2010). In terms of the impact of diet on health, it has been estimated that an increasing number of people search the Web in order to obtain information regarding the prevention, treatment or alleviation of symptoms of certain medical conditions. Furthermore, online social networking websites provide an alternative source of knowledge and support via the formation of communities of people with the same concerns (Beck et al., 2014; Fox S JS, 2009; Farmer AD, Bruckner Holt CE, Cook MJ, 2009;

Hawn C ,2009; Greene JA, Choudhry NK, Kilabuk E et al ,2010; Ravert RD, Hancock MD, Ingersoll GM ,2004).

The purpose of the content analysis study was to document for the first time the exchanged information and ideas available on the Web among a special group of people interested in a kind of food which is not industrially produced, the homemade NAFB. Thus, an in-depth examination of information on websites, blogs and forums presented in on-line comments by visitors about this topic, was conducted. We applied an extensive first- and second-generation sampling methodology and a detailed coding manual. The available information was processed and evaluated and theme categories of the visitors' on-line comments as well as, threads of their concerns were comprehensively summarized.

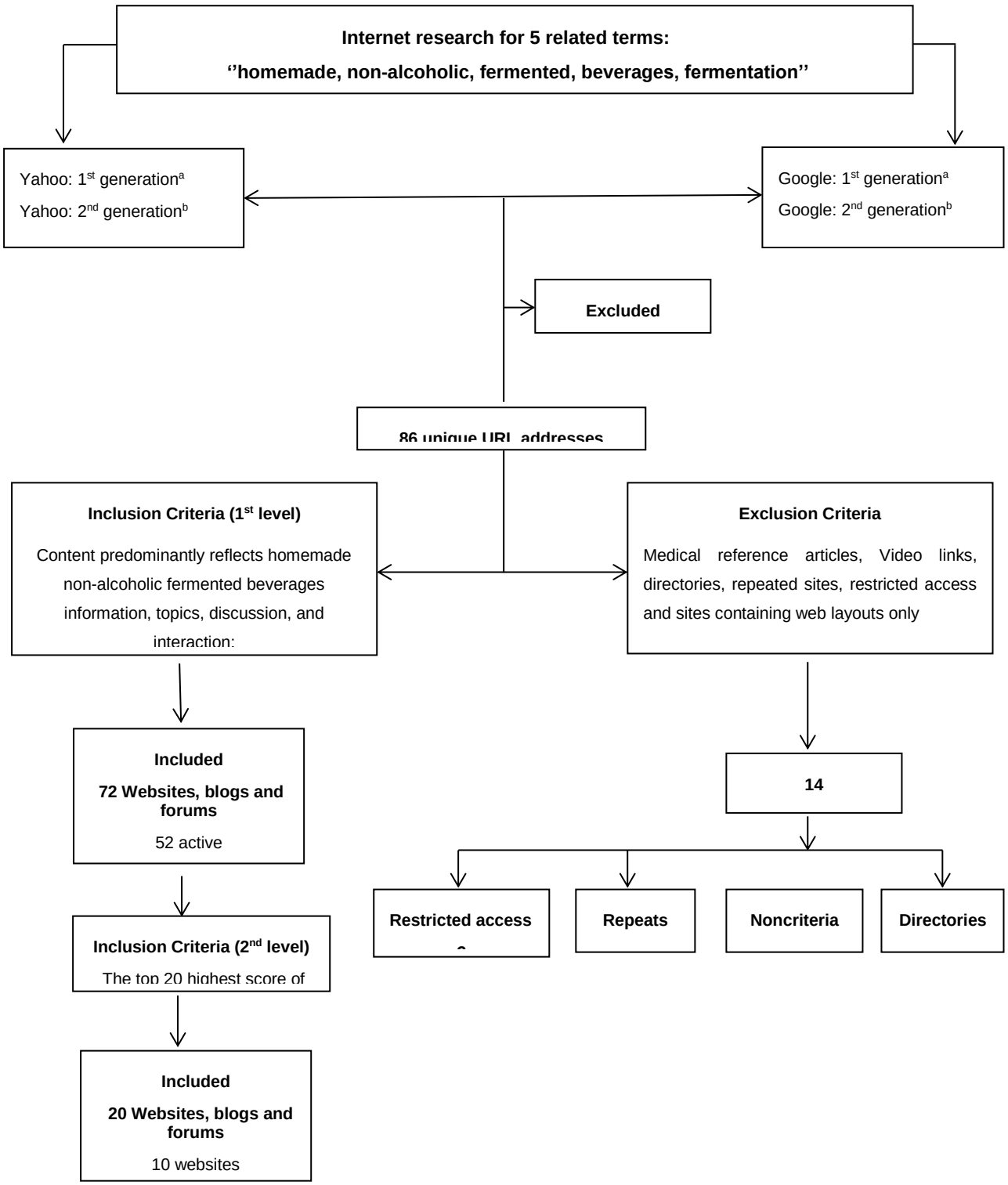
5.2 Material and Methods

5.2.1 Study material and data collection

In order to obtain a valid and representative sample for a systematic content analysis, we first established a population of websites, blogs and forums in the English language dealing with homemade NAFB information, topics, discussion, and features, using Yahoo and Google search engines (**Figure 6**). Five terms were included in our search, as follows: "homemade", "non-alcoholic", "fermented", "beverages", "fermentation". The first 5 pages of search results for each term from each search machine were used to generate a list of relevant websites, blogs and forums (''first'' generation). Subsequently, viable links offered on these sites were included in the sample (''second generation''). This resulted in a total of 86 pertinent unique URL addresses. All websites, blogs and forums characterized by a primary focus on or promotion of homemade NAFB were included in this level of our search. Medical journals, video links, directories, repeated sites, sites with restricted access and sites containing web layouts only, were excluded. A total of 52 active websites, blogs and forums met the first level of criteria for our analysis. Next, from this list we selected the top twenty (20) websites, blogs and forums with the highest PageRank of Google PageRank (Google PR), which is one of the methods used to determine a page's relevance or importance (second level of inclusion criteria) for a given topic.

The duration of the study was between 1th April 2014 and 31th March 2015. Selected websites and blogs were visited by the authors of this paper on a regular basis (every three months) during a 12-month period and their content with regard to types of homemade NAFB, preparation methods, cultural aspects, ways of promotion, and messages regarding their health effects, were

recorded and evaluated. Almost all the websites, blogs and forums examined were available in the public domain and only 20% (n=4) required approval from a maintainer for the exclusive entry to certain pages. In these cases, we collected data from the publicly available portions only.



[a] Links from the first 5 pages of results that fit criteria

[b] Links found on the first generation Web pages

Figure 6. Establishment of the study sample of homemade NAFB websites, blogs and forums: 2014.

Our research focused on identifying ‘’wall comments’’ and ‘’discussion topic comments’’ related to NAFB and collecting visitors’ comments regarding these beverages. ‘’Wall comments’’ include comments made by visitors of a webpage and serve as a way of expressing their opinions and concerns about a given topic or to communicate with other visitors. ‘’Discussion topic comments’’ refer to comments made by a Web based discussion group which sets a certain topic for discussion, in order to share thoughts, ideas and opinions. For simplicity reasons we would refer to wall comments and discussion topic comments as ‘’on-line comments’’. During 12 months we identified 157 webpages in these twenty sites, blogs and forums providing information regarding various traditional homemade NAFB originating from different parts of the world. In these 157 webpages, 2,319 wall comments and 30 discussion topic comments were included. Sixty six (66) webpages did not contain any comment (9 webpages, 13.6%) or did not give the opportunity to the visitor to post a comment/response (49 webpages, 74.3%) or the visitor could have access to the comments only after subscription/registration (9, 12.1%). To monitor and track visitors’ concerns about these beverages, we gathered information from the comments which were written by the webpages’ visitors.

5.2.2 Data processing

Two evaluators assessed the on-line comments. They read all the selected on-line comments carefully, developed descriptive codes and applied them to the data. After the assessment of approximately 25% of the data, new descriptive codes did not occur. A high degree of agreement was achieved between the two evaluators upon assigning the codes to the data. All discrepancies between the evaluators were discussed thoroughly until a consensus was reached. Unique visitors were identified by only one researcher, in order to avoid the coding of multiple occurrences of a statement by the same visitor more than once. After the closure of the research the data were cleaned using Microsoft Excel. For the conduction of the analysis codes were entered into a database of SPSS 13.0 software for Windows (SPSS Inc, Chicago, IL, US). Analysis was both quantitative and qualitative and all the variables were categorical. Results on the profile of the related sites, blogs and forums as well as, on on-line comments are reported as frequencies and relative frequencies. Regarding on-line comments, frequencies and relative frequencies refer to comment content and how often a user posts a comment.

5.3 Results

The study material was abstracted from twenty sites, blogs and forums related to various homemade NAFB and included 2,349 individual comments on comment walls and discussion boards written by 1,607 unique visitors (range 1-102 in each post). We analyzed all the on-line comments written in our database and we found that the duration of communication in those comment walls and discussion boards ranged from less than 1 day to over three years (1,188 days). During the 12 months period of the study, the majority of the visitors (1,350, 84%) only wrote one comment/response, while a smaller number of the visitors (257, 16%) posted more than once. The maximum number of posting from the same visitor was 41 times. Among the visitors, 611 (38%) reported producing homemade NAFB, 691 (43%) were interested in making these beverages, 209 (13%) were promoting products while 96 (6%) had irrelevant concerns.

5.3.1 Themes of the on-line comments

All the comments on comment walls and discussion boards were assigned to at least one theme category. Based on the issues, visitors commented about, 11 theme-categories were identified (**Table 12**): [1:] health, in which a comment/response shared the user's own experience and advice regarding health benefits, digestive issues and side effects, [2:] organoleptic characteristics of the beverages, in which the visitor stated his/her opinion or experience or asked for information regarding the taste, flavor, color and texture of the ingredients of the beverages, [3:] methodology, in which the visitor asked for advice or gave information regarding the preparation and preservation process of a beverage, [4:] nutritional features, such as the nutrient, alcoholic and caffeine content of the beverages, [5:] modes of preparation and consumption of different beverages and their variants, [6:] compatibility with religious and other dietary guidelines (prohibitions), [7:] eco-gastronomy, in which visitors ask for or give information regarding food waste, the cost and variations of use in different cultures, [8:] recommendations, in which visitors required/provided or commented on information regarding the safety of these beverages or on their suitability for children, pregnant women, athletes and lacto-vegetarians, [9:] novel versions, in which different versions of these beverages, their use as substitutions of ingredients in recipes, for example fermented milk instead of raw milk and other possible culinary uses were discussed, [10:] procurement, in which visitors require or provide information on ways to purchase cultures, starters or ready to drink NAFB, such as specific stores, sites/blogs and on line groups, [11:] marketing information, in which visitors could find information regarding specific brand names

or characteristics of these products. **Figure 7** represents the relative frequencies of these theme categories as a percent of all on-line comments.

Table 12. Theme categories of the on-line comments on comment walls and discussion boards.

1	HEALTH
	Benefits
	Digestive issues
	Side effects
2	ORGANOLEPTIC CHARACTERISTICS
	Taste
	Flavor
	Color
	Texture
3	METHODOLOGY
	Preparation
	Preservation
4	NUTRITIONAL FEATURES
	Nutritional content
	Alcoholic content
	Caffeine content
5	MODES OF PREPARATION AND CONSUMPTION
	In different countries
	Variants of specific beverages
6	PROHIBITIONS
	Alcohol content
	Tea content
7	ECO-GASTRONOMY
	Food waste
	Cost
	Variations of use in different cultures
8	RECOMMENDATIONS
	Safety
	Suitability for special groups
9	NOVER VERSIONS
	Different versions
	Substitutions of ingredients in recipes
	Culinary uses

10	PROCUREMENT
	Stores
	Sites/blogs
	Online groups
11	MARKETING INFORMATION
	Brand names
	Special characteristics

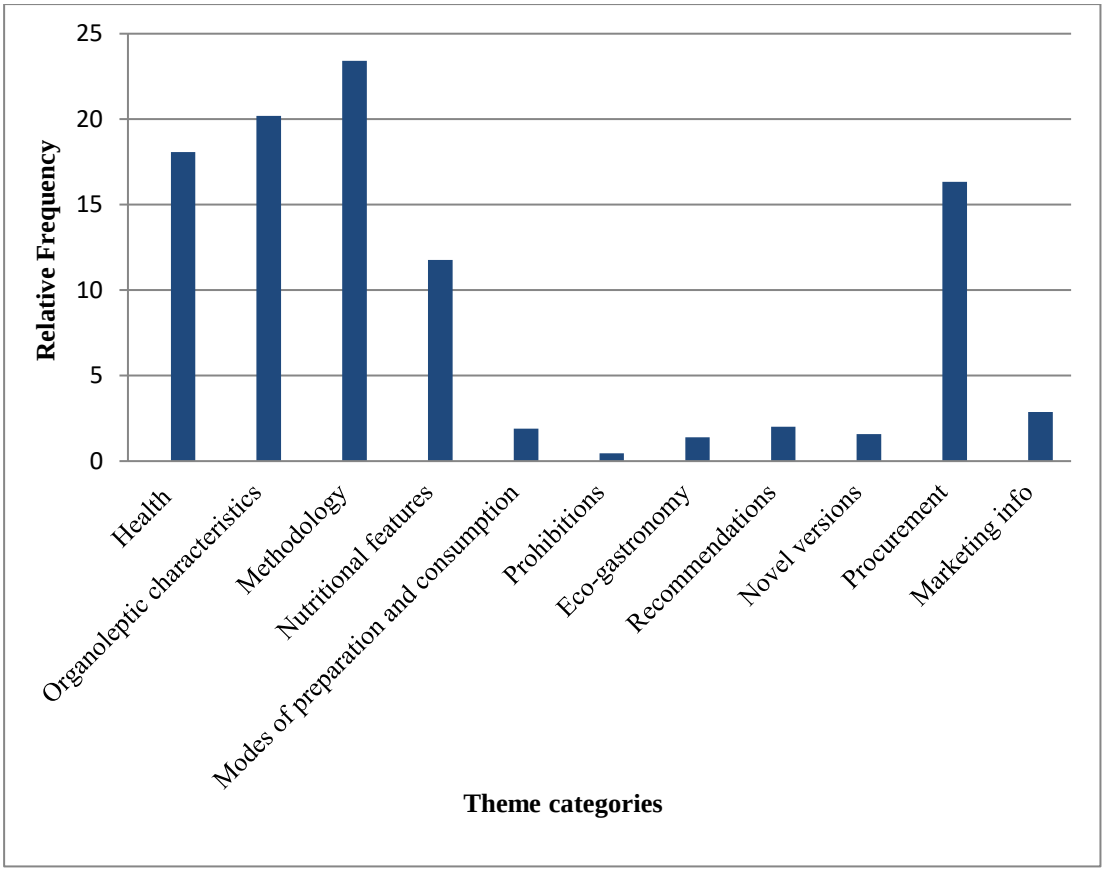


Figure 7. Relative frequencies of theme categories in the on-line comments coded. (n=2,349)

5.3.2 Concerns of the visitors in regard to NAFB

A further examination of the themes we identified revealed four prominent threads (**Figure 8**): (i) health and preventive nutrition, (ii) homemade food, (iii) ethical and cultural concerns, (iv) web as a promotion tool; these are presented in detail below.

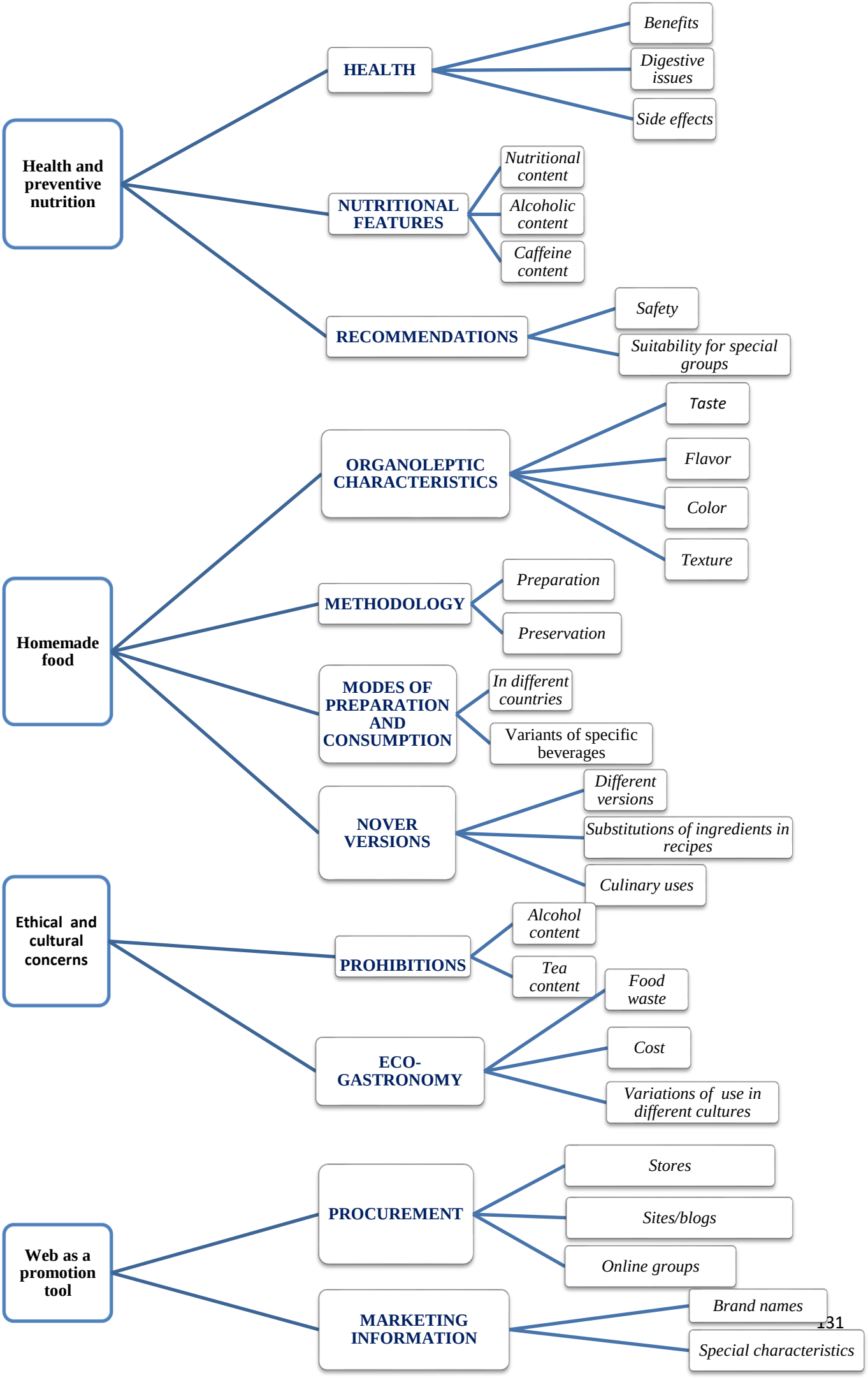

Health and preventive nutrition
HEALTH
Benefits
Digestive issues
Side effects
NUTRITIONAL FEATURES
Nutritional content
Alcoholic content
Caffeine content
RECOMMENDATIONS
Safety
Suitability for special groups
Homemade food
ORGANOLEPTIC CHARACTERISTICS
Taste
Flavor
Color
Texture
METHODOLOGY
Preparation
Preservation
MODES OF PREPARATION AND CONSUMPTION
In different countries
Variants of specific beverages
NOVER VERSIONS
Different versions
Substitutions of ingredients in recipes
Culinary uses
Ethical and cultural concerns
PROHIBITIONS
Alcohol content
Tea content
ECO-GASTRONOMY
Food waste
Cost
Variations of use in different cultures
Web as a promotion tool
PROCUREMENT
Stores
Sites/blogs
Online groups
MARKETING INFORMATION
Brand names
Special characteristics

Figure 8. Schematic presentation of the threads, the theme categories and subcategories of the visitors' on-line comments.

5.3.2.1 Health and preventive nutrition

Almost one third (30%) of the on-line comments shared information, personal experience and advice on the role of NAFB in treating or curing specific health problems and disorders. For instance, visitors provided or requested information about possible health benefits of NAFB in liver function and liver cleansing properties, the stomach and the gut, diabetes and blood sugar regulation etc. Other on-line comments highlighted the importance of NAFB in digestion and in particular, their efficacy in promoting healthy digestion by repopulating the digestive tract with good bacteria, such as probiotics and preventing candida overgrowth. As an example, a new member requested information from the owner of a blog about the properties of milk kefir:

'' I wondered how long it takes after drinking Kefir for the body to start to 'heal'? Or in the case of intestinal problems, how much should you consume daily and for how long before you will feel a difference?.....

And the owner of the blog answered:

''Everyone is a little different. So I always suggest you try anything that might help you feel better and if it doesn't work for you in about 3-4 weeks then just mark it off of the list. I've heard of kefir helping candida and not helping it…..

A number of visitors reported adverse effects after NAFB consumption, trying to find out if their own experiences are matching with that of others. The following comment regarding the consumption of kombucha, a NAFB traditionally prepared from black tea and white sugar , triggered the post of many responses claiming adverse events:

''Also has anyone heard of a reaction of kombucha after months of drinking it, like a rash only on the neck which is itchy, dry, peels?''

Also, many visitors reaffirmed the statement of previous on-line comments by presenting their own experiences and history of preparing and consuming a NAFB and the following adverse effect:

'' I made my own kombucha, but drinking it gave me the kind of headache I get from cheap red wine. Has anyone else had this problem?

Our examination showed that the synthesis of the NAFB, and especially their alcoholic and caffeine content, is of concern for some visitors, for instance in the case of ginger beer:

''Well this (ginger beer) looks very good! So with the yeast I am assuming it creates alcohol???''

Caffeine content is also an issue that concerns many visitors, especially mothers who wish to provide a healthy and balanced diet for their children and patients who are advised to limit its consumption. For example:

''I have a problem here with Kombucha. I'm allowed nothing with even a hint of caffeine in it. Any suggestions what I could use as a base?''

Posters usually confronted questions of nutrient profile and caloric content of NAFB. A great number of discussion threads were initiated by visitors, who presented themselves as enthusiasts of healthy and preventive nutrition. Most of the on-line comments focused on sugar and carbohydrate content, probiotics, recommended daily intake and alterations in nutrient content after fermentation.

''Very interesting. I hadn't heard of matsoni or blaand before. Cultured raw dairy is a healthy food if you don't add any sweetener….If you just have to make it sweeter, adding a little fresh fruit is the healthiest way. Most commercial cultured milk is loaded with sugar or artificial sweeteners and should be avoided.

''A couple of questions: the sucrose is converted to fructose. While this doesn't impact blood sugar, isn't fructose worse for you overall?.....

Questions and recommendations regarding safety of consumption and suitability for special groups of people, such as athletes, pregnant women and children, lacto-vegetarian etc. are reported in many discussion threads.

''Fermented milks are so much easier to digest, even babies can eat cultured milk products like yogurt and cottage cheese (from about 7 months)

''Is there a risk for botulism through using honey to ferment tea? ''

Many of these discussions also resulted in arguments, as some of the posters are trying to persuade others about the safety of particular beverages. This is obvious in the following on-line comments below:

''Kombucha is a medicinal tonic, not a replacement for water – small frequent amounts, coupled with an equal amount of water is optimal….''

''Is it okay to drink kombucha while nursing?''

And another visitor replied:

''I've read some sources that say no, but most agree that as long as you start with small amounts like 4-6 ounces when you are first drinking it……..''

5.3.2.2 Homemade food

Visitors' comments on the methodology of preparation and preservation of homemade NAFB and their organoleptic/sensorial characteristics represented almost one fourth of total on-line comments examined (23.4%). Most of them were concerned about the preparation process (80.2% *versus* 19.8% for the preservation process). On-line comments in this category refer to details of the process of fermentation, time-length of fermentation, the proper temperature while fermenting homemade NAFB, different recipes (especially for children) and sharing family recipes with other visitors and eliminations or substitutions of ingredients as a healthier option, such as substituting sugar with agave nectar. For example:

''You want your brew to optimally be at aprox 75 F. If you need to heat, it is best not to heat from the bottom as this over stimulates yeast which can then take over and starve out the beneficial bacteria……..''

''I made homemade root beer the start time and I used champagne yeast. My question is how do you open the bottle without the root beer shooting out the top of the bottle even after you crack the cap to let the gas to escape?''

The preservation section consists of on-line comments that contain or require information mainly for the storage of the final product, the period of time which is best consumed and the cleansing of the storage equipment. Some examples are presented below:

''Can be frozen and then thawed and used?''

''Do kefir grains ever go bad?''

Visitors seek or gave information regarding the taste, flavor, color and texture of the final product. They had concerns about the sweetness or sourness of their homemade NAFB, stated personal opinions about other NAFB they had tasted, required information about appealing recipes for kids or the possibility that specific ingredients may alter the taste of the final product, assessed the flavor and taste of their own homemade NAFB and shared intimate experiences

with these beverages. Selected on-line comments are given below and provide examples of the above:

''If you don't like the flavor of the kefir, you can use yeast. My brewer recommended champagne yeast. It will taste more like what you are used to buying at the store but the roots will be more flavorful''

''This is a fantastic recipe for ginger beer. It takes me back to my childhood in England''

The analysis of the on-line comments also revealed that the possibility of producing novel versions of homemade NAFB was an appealing project for the visitors. Thus, they required or gave information in preparing healthier versions of these beverages, such as low-fat, low-sugar, low-salt, lactose-free, caffeine-free and diabetic versions. They were also seeking information regarding the possibility of these beverages serving as substitutes for other foods or ingredients and also if these beverages may have other gastronomy uses. These observations are illustrated in the following on-line comments:

''I' m substituting agave nectar for the sugar, it is more diabetic friendly''

''Can it be a substitute for raw milk in order to make a baby formula?''

''Beet kvass can be used not only as a beverage but also as a salad dressing''

A great number of on-line comments contained storytelling threads as a result of a group of responses to the query *''Does anyone have experience of preparation or consumption of kefir or kombucha or any other similar beverage?''*. Visitors presented their experiences of preparation and/or consumption of different NAFB or of a certain NAFB in different countries. For example:

''While living and traveling with the Bedouin of Egypt our camels' milk was re-cycled through bladder's tied to humps, …… Kefir is an undying treat from pantry shelf to village hut and outward bound into a sea of culinary possibilities! ''

''.....I live in the bush in central Canada, where we have a number of root-beer ingredients growing wild. I like to drink the kombucha ……My sister in law is from Kazakhstan and grew up with a jug of kvass on her counter.''

5.3.2.3 Ethical and cultural concerns

A number of on-line comments/responses reveal the sustainability and eco-gastronomy concerns of the visitors regarding NAFB. Visitors were providing or requesting information about food waste, cost of these beverages and variations of their use in different cultures. From the analysis

of the on-line comments, it was obvious that visitors had raised awareness of preventing and reducing food waste, which in turn strengthen sustainability of the food system.

''Plastic is full of carcinogens, you should use glass. It will have a crisper flavor……..''

''How many times can kefir grains be re-used?''

''For the preparation of milk kefir, collect the cheese whey, use it and keep the rest in the fridge for next use''

Furthermore, the low cost of the preparation of NAFB is very appealing to the visitors and they usually ask for more details about the costs of their homemade preparation. For example,

''How much does the homemade preparation of beet kvass cost?''

''Milk kefir is my favorite fermented food! It is so easy to make. Because the milk kefir grains are reusable, they are an easy inexpensive way to make kefir forever! .....?''

In terms of the different ways of use, some visitors describe different ways of consuming or preserving these beverages. The following query is an excellent paradigm.

''I remember my mother fermenting juices and then make popsicles with them. In this way, we could have fermented juices all the seasons''

Visitors also seek information regarding the safety of NAFB, such as water kefir due to alcohol prohibition for religious reasons. As NAFB may contain small amounts of alcohol (a result of the fermentation process), a limited number of visitors post comments or responses requesting specific information on alcoholic content and safety of consumption for these beverages. The post cited below is an example.

''I don't drink alcohol for religious reasons. Is kefir safe for me?''

Some visitors state their wish to abstain from tea, as a result of their religious beliefs. Thus, they ask for alternatives, such as NAFB and ways of preparation and preservation, for example:

''I don't drink tea for religious reasons, so I cannot drink kombucha. Is there a way to make water kefir continuously?''

''If you cannot use caffeinated tea because of religious reasons, I recommend you find a different tonic, as kombucha needs to be made with the tea plant.''

5.3.2.4 Web as promotion tool

Product promotion was predominant in 19.1% of on-line comments, while the majority of them contained information about the procurement of NAFB from stores, for example from organic groceries or supermarkets and also the supply of starter cultures or ready to drink NAFB. Also, some visitors were willing to share or sell starter cultures for the preparation of homemade NAFB. For example:

''Info about people willing to share culture "babies" for free''

''Can I get the coconut water kefir at a healthy store locally?''

A smaller group of visitors was requesting information or was suggesting sites/blogs that sell starter cultures or ready to drink NAFB.

''I've been searching for a kombucha that I can stand. So glad I've found http://fabulousferments.com/ in Cincinnati, Ohio……''

''I've been making my own Kombucha for about a year now from a scoby given to me by a woman who was blogging about it.''

An even smaller number of on-line comments referred to recommendations/suggestions of online groups or social networking groups that give information about homemade fermentation or share/buy starter cultures. These on-line comments reflect consumer trust in social media-based information in order to promote their products or to buy these products. Representative examples are shown below.

''Very much want to be in a group for brewers to learn more. I am already in the LinkedIn Kombucha group''

''Is there a Facebook group for fermenters?''

''HI Kim ~ Scobies can be obtained online pretty easily……Or ask around your local community through your health food store……. there is also an online group that you can get a scoby for free ……''

Requests and recommendations for certain brand names of theses beverages or their starter cultures and first-person testimonials about their special characteristics were presented in a number of on-line comments. Also different names of brands of these beverages in different countries or regions were also referred.

''You can find Ke Vita in certain supermarkets or healthy stores. It is the best coconut water kefir''

''..... Buy a bottle of Kombucha that has some of the slimy goodies in it. K.T. is a great brand or if you are in Austin, TX Buda's Brew is a wonderful local brand. .....''

5.4 Discussion

Despite the overwhelming trend of consuming ready to eat foods and meals, homemade food and beverages are deemed to confer many health benefits. Homemade food is also linked to other beneficial habits, as research has shown. Recently it has been found that families who eat more fast-food meals than home-cooked ones, are less likely to eat fruits and vegetables, and have an increase in consumption of salty snacks and soda (Boutelle et al., 2007). Preparation and consumption of homemade food may also help people, especially children and teenagers, to adopt healthy eating habits. In addition, it can serve as a way of supporting local farmer/processors *versus* the global market (Halweil, 2002). Moreover, people are generally innovative and creative and the new trend of ''homemade'' beverages reveals the fact that even people who do not have tradition for NAFB in their own culture, they have the urge to acquire know-how and also to evolve the whole procedure of preparing and preserving them.

One easy way for seeking information for these beverages is searching the Web, posting comments and participating in global digital discussions in websites, blogs and forums which focus on homemade NAFB. To the best of our knowledge, our study is unique in analyzing in depth the content of the information which visitors shares regarding homemade NAFB, while it also reveals their profile characteristics. Content analyses, such as the one described here, provide systematic data on what is available and likely to be seen by visitors in the comment walls and discussion boards of homemade NAFB related websites, blogs and forums. Our study showed that many traditional beverages, such as homemade NAFB, originating from different parts of the world have found their way in the everyday life of the visitors.

The analysis of the on-line comments of the visitors of the websites, blogs and forums reveals that the major themes categories were firstly the methodology of preparation and preservation of the beverages, and then their organoleptic characteristics, as well as health and nutritional information. In practically every message wall and discussion board there were questions addressing the preparation and preservation methods and the organoleptic characteristics of the final product. Many of the viewers were beginners in homemade fermented foods/beverages and they wished to be informed about their mistakes or to know all the details regarding every stage of the process. Personal experiences or opinions for the consumption, mainly from viewers living in different counties or regions, were of special value because they provided a different insight

into the research by posting different names, recipes or different ingredients for the same beverage.

Visitors also raised many questions about the impact of these beverages on the function of certain organs of the human body, such as the liver, stomach and intestines, on food allergies and on particular age groups (e.g. children, pregnant and lactating women, weight losers, athletes, lactose intolerant people, and so on). The most common questions regarding particular age groups concerned digestive issues, safety and hygiene matters, portions for consumption, and the alcohol, caffeine and nutrient content of the final product. Some visitors also seek information regarding the content of alcohol of NAFB due to alcohol prohibition for religious reasons. They had also the tendency to become innovative and to differentiate the ingredients of the initial recipe in order to produce a final product of their own choice. They were interested in producing homemade versions of NAFB, using less sugar or/and salt or low calorie ingredients. They thought that these beverages may be used as alternative choices for children and adolescents as well as for adults.

A large proportion of the on-line comments addressed financial issues, concerned eco-gastronomy as well as food wasting, the costs of the final product (homemade versus commercial) and practical ways of consuming or preserving these beverages. In addition, a big number of visitors offered information about certain stores e.g. web stores, sites/blogs or online groups, which sell these beverages or their starter cultures or even offer them for free, gave recommendations for special brands and commented on some of their special properties, mainly their organoleptic characteristics.

Our findings allow us to identify some of the major concerns underlying visitors' choice for producing homemade beverages. A part of the on-line comments focused on nutrition for health promotion and disease prevention. Visitors were concerned about the adoption of a healthy lifestyle, eating fruits and vegetables, reducing fat, sugar, salt and alcohol, preparing food in a safe and hygienic way and maintaining a body weight between the recommended limits. The choice of a healthy lifestyle which is based on preventive nutrition has been a growing trend among people in western societies (Von Essen and Englander, 2013). Moreover, the choice to follow a particular dietary pattern gives the person the opportunity to belong to a group of people in the community with similar interests and values and unique ways of communication (Hunt G et al, 2011). Another major concern was sustainable nutrition, referring to the physical and economic access to sufficient, safe and nutritious food and water in order to achieve a healthy lifestyle. Visitors' comments on sustainable eating and nutrition concerned food production, consumption and security, income, public health and economics**.**

A very significant concern of the visitors was the purity of the food and the beverages consumed, in terms of their content in preservatives, colorings, additives, chemical fertilizers and inferior ingredients and the impact of the food and beverage impurity on their health. On the other hand, home fermentation is a way of preserving the food and beverage purity and the fact that the majority of NAFB are traditional ones contributes to this direction. For this reason, it has been observed that this certain social group has a great interest in these beverages, which are very often presented by them as ‘’organic’’ beverages.

The present study has certain limitations though, which should be taken into account when interpreting the data. First, it should be kept in mind that websites, blogs and forums are dynamic and sometimes short lived. A revisit to the sampled on-line comments might reveal new data. The period of time for the collection of the data (12-month period) may be limited, and thus we could have gathered more longstanding or repetitive features of information exchange in the case of a longer study. Although we visited these sites, blogs and forums on a regular basis (every three months) during a 12-month period, some data might have been missed, thus more regular monitoring might be needed.

Furthermore the selected 20 sites, blogs and forums related to various traditional homemade NAFB might not be the only way of communication of people interested in these beverages. Maybe online social networking, such as Facebook, Twitter and Pinterest could reveal more information regarding their concerns and motivations. A final limitation concerns the subjectivity involved in an analysis such as ours. We did not have multiple researchers consider the data objectively and the selection of the variables, their features, and the content analysis of the on-line comments may thus be biased.

Regardless the limitations, however, our study provides a methodology for a systematic examination of an enormous database with elusive material, i.e. the behavior of sharing and seeking information through the Web by a big number of people interested in homemade NAFB. We uncovered the perspective of a community exchanging information and experiences and also educating each other for achieving the optimal result in preparing, preserving or buying these beverages. Beverage industry could benefit from the results and observations of this study and consider them in order to produce their standardized types in accordance to consumers’ behavior and attitudes. Furthermore, the involvement of health professionals, such as nutritionists, agriculturists, food technologists etc. in the reply of the on-line comments of the visitors will result in the provision of more scientific and precise information.

Because technology is constantly advancing, these websites, blogs and forums will evolve and change. It is also clear from our analysis that the population under study consists of dynamic

communities with ever-changing, user-contributed content. Although we have provided a methodology to evaluate information available on the Web about these beverages, different methodologies must be employed to analyze in depth their content and to determine whether and how exposure to such material and media affects visitors. To better understand how messages with the potential for good or harm are communicated through such media venues, researchers must continue to investigate both the messages to which an individual is exposed and their impact. Furthermore, more research is needed in order to clarify the association between healthy/organic dietary patterns and the psychosocial and psychological well-being of people.

5.5 Conclusions

Home food and beverage fermentation seems to be a resurgence of interest for a group of people in western world. NAFB have a long tradition in many cultures all over the world and have gained peoples' interest and attention, especially for their health benefits and for their positive impact on food sustainability, eco-gastronomy and purity of the food. Web enables the communication and education of people who are interested in preparing and consuming NAFB in real time and also in a cheap and convenient way. This Web community has unique characteristics and behavior which have to be better investigated and evaluated in order to explore and understand their concerns.

The results of the 3rd study have been published in the form original work in the International Journal of Food Science and Nutrition [Aristea Baschali, Effi Tsakalidou, Adamantini Kyriacou, Antonia-Leda Matalas. Understanding consumers' perceptions, behavior and attitudes towards homemade non- and low- alcoholic fermented beverages in on-line comments: A content analysis. IJFSN 2017 May; 2(3):58-67]

CHAPTER 6: GENERAL CONCLUSIONS AND FUTURE PERSPECTIVES

NAFB constitute an important part of the cultural wealth and culinary heritage of many populations worldwide. They are a unique and under-researched food category, not comparable to any other type of liquid food. The main purpose of this research was to investigate the place that NAFB have in the diet of modern European citizens and to critically examine the evidence on their health effects, considering NAFB as a distinct group. NAFB share specific features which distinguish them as a group from the other beverages and foods. They rightfully belong to ‘’traditional’’ beverages as they are the outcome of primary products which undergo a traditional type of production and/or processing method. In this respect, we aimed at uncovering the diversity of NAFB consumed, as well as the factors responsible for this diversity.

The present thesis revealed a considerable diversity of traditional NAFB produced and consumed by modern European populations. Based on our research, this diversity can be attributed to a number of factors. Of prime importance is the experimentation with raw materials which, not only represent different food categories (e.g. milk, cereals, fruits, herbs etc.), but different products within each one food category (e.g. cow milk and sheep milk, within the milk-group). A second factor is diversity of indigenous microbiota of fermentation that prevails in the various settings. Indigenous microorganisms involved in the fermentation process of any NAFB vary markedly from region to region, even among households within small geographical regions. The existing variability in the applied processing parameters and the different fermentation regimens also contribute to the diversity of NAFB. The highly changeable process of NAFB preparation often results in slight fluctuations in their alcoholic content. For this reason, homemade NAFB usually have small differences in their alcoholic content, however these never seem to exceed the limit of ABV for non-alcoholic beverages (1.2% or less).

Milk-based NAFB, such as kefir, ayran and buttermilk are the dominant ones, but NAFB made of cereals (such as boza and kvass), herbs, spices and aromatic plants (such as Kombucha and ginger beer*)* as well as, sucrose-based NAFB (such as sima and water kefir) have also a place in the tradition of some European regions; while fruit-based NAFB (such as hardaliye and gilaburu juice) and vegetables-based NAFB (such as sauerkraut juice and salgam juice) are predominant on a regional level.

In regards to the geographic variance, we reached to the following conclusions. First, for the indigenous fermented milk, the greatest diversity was documented for Scandinavian countries. This finding may be attributed to the breeding of large size animals, such as cows, as well as, to the large volume of milk produced in these countries. It was also documented that production

and consumption of whey-based NAFB is more prevalent in Central Europe, for instance in Romania. Whey is the by-product of cheese and the fact that these regions are cheese producing could explain this finding. Traditional cereal-based NAFB were found to be popular in East-Central Europe; while fruit-based, vegetable-based and herb/aromatic plant-based NAFB are present in the diet of a number of different European countries. It is noteworthy the traditional versions of these beverages hardly occur in Western European countries anymore, although these countries hold a long tradition of producing other fermented foods and drinks (beer, wine, cheese and cured meats).

Previous research has been conducted in order to scientifically substantiate the health benefits of traditional NAFB, but the evidence was either product-specific (eg. kefir, kombucha, ayran) or strain-specific (eg. *Lactobacillus helveticus* strains in fermented milks). Taking into account this body of evidence, it is difficult to come to a conclusion. It is important to understand that NAFB are unique products with biological importance. Their preparation and hence their health benefits depend on a number of factors, such as raw materials, fermentation microbiota, applied processing parameters and the different fermentation regimens, the application of biotechnology etc. For this reason, the achievement of a uniform NAFB is an extremely difficult task.

To better understand whether and how the various categories of NAFB confer health benefits to the host, an interdisciplinary approach was adopted. Thus, the nutritional benefits and health implications of NAFB was examined through a synthesis of the available evidence from the different disciplines of health sciences. The research based evidence on this relationship focused mainly on fermented milks and herb, spice and aromatic plant-based NAFB. Kefir and kombucha were the most studied NAFB. Published evidence on fermented milks provides substantial ground for supporting the potential of these beverages to modulate gut microbiota and thus, improve the gastrointestinal function. Furthermore, many traditional NAFB, especially milk-based NAFB, are good sources of probiotics and, when taken up in adequate amounts, confer a health benefit on the host. A body of evidence supports the hepatoprotective properties of kombucha and its antioxidant capacity. Moreover, the evidence supports the notion that the end products of fermentation of traditional NAFB are of great importance on diet and health. Substantiated benefits include the enhanced digestibility of lactate and free amino acids in fermented milks, the hepatoprotective, immunoprotective and gastroprotective properties of glucuronic acid of kombucha, the antimicrobial properties of bacteriocins in kefir and the production of certain vitamins in kefir, kombucha and boza. With respect to the potential of harming human health, the evidence on NAFB is fragmentary. Thus, their content in biogenic

amines, the adverse effects of kombucha in the stomach and liver and the possible contribution of kvass to chronic alcoholism raise concerns and need to be further examined.

Nowadays, a resurgence of traditional NAFB among a group of modern citizens has been observed. In our research we documented and analyzed the attitudes, beliefs and concerns of modern NAFB home fermenters, depicted in on-line comments from websites, blogs and forums related to homemade NAFB. We found that modern home fermenters' profile, choices, concerns and motivations are unique and differ from those produced by home fermenters in the past. Based on our findings, home fermenters can be classified as a community with a strong interest in tradition, health, food sustainability and purity in dietary intake. NAFB are regarded as ''pure'' by home fermenters who integrate them in their everyday activities. They also feel the need to share their views and taste preferences with like-minded people.

Homemade NAFB are at large non-standardized products, thus, each one of them is unique and reflects the individual practices and taste preferences of its manufacturer. Moreover, they can be considered as ''live'' foods, as they contain live microorganisms and are characterized by a changeable composition and consistency. Our study showed that modern NAFB home fermenters usually prepare a number of different traditional NAFB, with kefir and kombucha being among the common ones. Apart from these traditional variants, home fermenters also tend to become innovative by modifying ingredients in the recipes to produce final products of their own choice. The substantial diversity of traditional NAFB, as well as of their innovative types manufactured by the beverage industry and/or home fermenters, supports the notion that NAFB are a food category with a large of potential.

Our analysis of the comments posted by home fermenters allows to gain an understanding of the concerns underlying the choice for producing homemade beverages: the focus is on health and preventive nutrition. The majority of the themes shared such concerns, i.e. the evidence-based health effects of the NAFB they chose to manufacture. A great number of the on-line comments focused on the impact of homemade fermented milks (eg. kefir) on gastrointestinal health and their efficacy in promoting healthy digestion by repopulating the digestive tract with good bacteria, such as probiotics. Traditional NAFB have evidence-based effect on gastrointestinal health, such as improvement in gastrointestinal function, enhanced digestibility of by-products of fermentation in fermented milks, alleviation of lactose intolerance and probiotic effect. The hepatoprotective properties of NAFB were also mentioned in on-line comments, for example the impact of kombucha consumption on liver function and its antitoxic effect. This statement is in accordance with the evidence-based hepatoprotective effect of kombucha. The

immunoprotective effect of NAFB was also mentioned in on-line comments, for example the prevention of candida overgrowth in GI tract of fermented milks. Evidence-based effects of kefir and kombucha on immune system have also been reported in a number of studies. Home fermenters were concerned on the cardiovascular effects of NAFB, mainly for their potential to lower blood pressure, but the evidence for this impact is generally weak. Concerns on diabetes and blood sugar regulation were also expressed in on-line comments, although the evidence does not support this effect. Although a number of studies focused on the antitumor/antioxidant capacity and the antimicrobial properties of NAFB, as well as their impact on obesity, bone metabolism and bone mineral density, these concerns were not expressed by the citizens in their on-line comments . The potential health risks of kombucha reported in a few published studies were also mentioned in a number of on-line comments.

People nowadays are accustomed to technology and have an easy access to social media. In the past, the knowledge regarding the preparation of NAFB was transmitted from generation to generation. Our research has shown that nowadays this knowledge is acquired via novel venues, i.e. the social media. Some advantages associated with the use of social media are a faster transmission of knowledge and exchange of ideas, as well as, a parallel interaction with many people at the same time. However, transfer of knowledge from generation to generation has the advantage of being personal and intimate; this feature is lost with the social media communication and/or an in-depth relationship.

The limitations of this research include the language barrier, as our search in literature and in social media was limited to the English language. An expanded study seeking information on the purpose of this research in other national languages would have provided additional information and resources. In addition, a part of our research focused on the in-depth examination of information on websites, blogs and forums presented in on-line comments of users. Investigation of other social media, besides sites and blogs, would have also refined the present study (home fermentation participate in on-line social networking -Fermented Foods Challenge Facebook-, live broadcasting, e.g. Skype, and social media based on on-line video, e.g. live workshops and cooking classes in YouTube). The examination of related information from other online social media would also increase our data. Finally, during our research it became evident, that, with the exception of kefir and a few other traditional NAFB, it is extremely hard to locate sources on the origins and cultural significance of these products in the English literature, even within the historical and ethnographic studies.

Future research in this topic should proceed in a number of different directions. Firstly, it would expand upon the results found in this study to further investigate the nutritional value and potential health benefits of traditional NAFB and their innovations. Data on nutritional value will allow for NAFB to be included in national food composition tables. Among European countries, this piece of information is generally lacking for the majority of NAFB. The nutritional composition of innovations of traditional NAFB, formulated by the beverage industry or prepared by home fermentation, should also be studied. Future research would examine their nutrient content, the presence of substances other than nutrients, such as biogenic amines, and their impact on health. More evidence on the health benefits of NAFB will assist in the development of accurate and disease-specific health claims, as well as in the understanding of the role of NAFB in preventive nutrition. Also, the attributed toxic activity of biogenic amines found in some traditional NAFB, poses the need for regulatory authorities to adequately standardize their concentration limits. Further study on NAFB, their consumption trends and various uses by people represents another direction of future research. This research, in combination with the evidence of the impact of NAFB on health and nutrition, would allow the compilation of scientifically based regulation requirements by government authorities, as well as nutritional guidelines for fermented food and beverages. It should be noted that the majority of the nutritional guidelines worldwide contain limited or no reference to fermented foods or drinks.

The choice of a healthy lifestyle based on preventive nutrition has been a growing trend among modern citizens. People who follow particular dietary patterns usually belong to groups within the community with similar interests, concerns, and values. Notably, our study has shown that home fermenters have adopted a healthy lifestyle and are interested in preventive and sustainable nutrition, as well as purity of the food before their engagement in home fermentation. Future research could also examine whether modern citizens' engagement in home fermentation facilitates the shift towards a healthier lifestyle.

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APPENDICE A

i. Publications

APPENDICE B

i. Checklists

Checklist of each site, blog, forum

ADDRESS of the SITE/BLOG/FORUM…….

Type	Website	Blog	Forum	Other	
Accessibility	Open-access information	Requires registration/subscription			
Focus on	Addresses to the general public	Health care	Tourist	Food and Drink/ Cooking	Other
Address	Have a URL (Uniform Resource Locator)	Hosted through another site			
Support	Maintained by an individual	Maintained by a group			
Type of communication	Interactive	Read-only			
If interactive	Online forum	Message board			
If message board	Named posts	Anonymous posts			
Contact listing for site	Yes	No			

maintainers					
If Yes	Email contact	phone	Via postal mail at an Address	Fill in a form (name and email) and submitted	Other
Cited scientific literature	Yes	No			
Advertisements	Yes	No			
Retail type	Yes	No			
Promotion of information	Only written	Written and images/photos/videos			
Share info on search machines or on other social networking websites	Yes	No			
If yes	Google	Facebook	Twitter	Other	
Search engine	Yes	No			
Google Page ranking (grade)					

Checklist of each non-alcoholic fermented beverage

NAME OF NON-ALCOHOLIC FERMENTED BEVERAGE……

……

Source:……

Title:

Date of visit…… **……..** **Date of posting**

Traditional beverage	Yes	No			
Reference to origin	Yes	No			
If Yes	Europe	Asia	America	Africa	
Region of Europe consumed (mentioned)	Yes	No			
If Yes	East	West	Central	South	North
Preparation method (recipe)	Yes	No			
If Yes					
Main ingredient/s	Milk based	Fruit based	Vegetable based	Other	

Historical data	Yes	No			
Cultural aspects	Yes (past, present)	No			
Importance for special age groups	Yes	No			
Information for nutritional value	Yes	No			
Way of promotion	Health claims	Cost	Other		
If Health claims	Probiotic content (effect on health, longevity)	vitamins	minerals	Other nutrients	Others
If Cost	Reducing the cost of nutrition	Better exploitation of perishables of foods	A way to consume certain foods in all seasons		
Audiovisual material	Photos	Videos	No		

Tips for home fermenters	Yes	No			
Statements/Opinions/comments	Yes	*No*			
If Yes					
Sale of the main ingredient/s	Yes	No			
Cited scientific literature	Yes	No			
Links to other sites	Yes	No			
Name of the writer	Yes	No			
Known side effects	Yes	No			
If yes					
Organic	Yes	No			
Data for how to purchase it	Yes	No			
Description of taste	Yes	No			
Reference to alcohol content	Yes	No			

ii. List of the websites, blogs and forums

1. http://blog.molliestones.com
2. http:// homemademommy.net
3. www.longecity.org/forum
4. www.about.com/food/#s2
5. www.allaboutturkey.com
6. http://allrecipies.com
7. www. culturedagedbrewed.com
8. www.culturesforhealth.com
9. http://divinehealthfromtheinsideout.com
10. www.fermentersclub.com/
11. http:// nourishedkitchen.com
12. http:// nourishingherbalist.com/
13. http:// rebeccawood.com
14. www. russian.lingualift.com/blog/
15. www.thehistorykitchen.com
16. http://thekitchn.com
17. http:// wellnessmama.com/
18. www.westonaprice.org
19. www.wisegeek.com
20. www.yourkefirsource.com

iii. List of the homemade NAFB found in the websites, blogs and forums and their explanation offered

1. **Acidophilus milk**: a regular milk enriched with acidophilus, a strain of healthy bacteria.
2. **Ayran**: is a yoghurt drink, it has been one of the most popular drinks of the Turks since the discovery of Yogurt among the Turkish tribes in Central Asia. It is simply made by diluting yogurt with water. Some salt is added to taste.
3. **Beet kvass**: probiotic fermented beverage made from beets.
4. **Clabbered milk**: is milk which has been allowed to naturally sour, becoming thick, tangy, and very rich. It is often sold in grocery stores, where it is called buttermilk.
5. **Boza**: is a popular fermented beverage ,It is a malt drink made from maize (corn) and wheat in Albania, fermented wheat in Turkey and wheat or millet in Bulgaria and Romania. It has a thick consistency and a low alcohol content (usually around 1%), and a slightly acidic sweet flavor.
6. **Chaas**: traditional buttermilk.
7. **Chal**: beverage of fermented camel milk, sparkling white with a sour flavor, popular in Central Asia.
8. **Chia seed Kombucha energy drink**: Chia Seeds and Kombucha combine to make a health boosting superdrink. Kombucha = fermented drink of sweetened black and/or green tea that is used as a functional food. It is produced by fermenting the tea using a symbiotic colony of bacteria and yeast, or "SCOBY".
9. **Cinnamon Apple Kombucha**: flavored Kombucha with cinnamon and apple juice or chopped dried apple or chopped fresh apple.
10. **Coconut milk Kefir**: is produced from the placement of the milk kefir grains in coconut milk.
11. **Cultured buttermilk**: is very similar to yogurt in the sense that it is cultured using live beneficial bacteria. Cultured buttermilk can be consumed as a thick and creamy beverage or used in cooking.
12. **Fermented Apple Juice**: produced from the placement of a powdered culture starter or sub liquid whey in apple juice.

13. **Fermented cabbage juice drink**: Cabbage is a natural source of Lactobacillus salivarius , a friendly bacteria needed for controlling unfriendly bacteria of the intestinal tract. It is produced from the fermentation of cabbage juice.
14. **Caschal**: a non alcoholic fermented soda, made with fermented juices **(**pear, apricot, berry**)** and fermented malt.
15. **Filmjolk**: is another treasured cultured dairy food. Its bright and tangy flavor is quite versatile. Filmjölk is not as thin as piimä, and neither as thick as viili. For this reason it's well-suited to a variety of applications. Filmjölk earns its tangy taste from lactococcus lactis and leuconostoc mesenteroides. These bacteria, like others involved in fermentation, render the milk slightly acid and that its acidic environment coagulates the milk's natural proteins turning the milk into sour, thick yogurt.
16. **Flavored Kombucha**: fermented drink of sweetened black and/or green tea that is used as a functional food. It is produced by fermenting the tea using a symbiotic colony of bacteria and yeast, or "SCOBY".
17. **Fruit Kvass**: made from fermenting ripe fruit eg unpasteurized honey with pure water and thin ginger slices or other seasonings (optional).
18. **Ginger beer/ale**: non-alcoholic beer made from fresh root ginger, often with other flavourings such as juniper, yarrow (which was once used as a preservative in beer instead of hops) or even nettles or capsicum.
19. **Kefir iced tea**: is produced by the fermentation of water kefir grains with unrefined sugar, non-chlorinated water, handful of fresh or dried herbs and stevia leaf or other optional sweetener.
20. **Kombucha**: traditional beverage prepared by fermenting sweetened black tea with tea fungus. Nowadays is a fermented drink of sweetened black and/or green tea that is used as a functional food. It is produced by fermenting the tea using a symbiotic colony of bacteria and yeast, or "SCOBY".
21. **Kombucha soda**: is a naturally carbonated fermented tea drink, made from the fermentation of brewed sweetened tea, black, green or herbal teas, and a SCOBY and liquid from a previous batch of Kombucha.
22. **Kvass**: is a traditional Russian beverage made from fermenting scraps of wheat or rye bread with water, starter culture and a bit of salt.

23. **Lacto-fermented ginger ale**: is produced by the fermentation of organic cane sugar, filtered water, ginger root and whey or water kefir (optional).
24. **Lacto-fermented soda**: it is produced by the mixing of sugar, water and culture.
25. **Milk kefir**: is a probiotic fermented milk drink made with kefir grains.
26. **Mors**: is a non-carbonated Russian fruit drink, prepared from berries, mainly from lingonberry and cranberry (although sometimes blueberries, strawberries or raspberries). It is made from fermented and clarified juices blending with sugar syrup and drinking water.
27. **Piima**: a thin fermented beverage, piimä is less sweet than viili and faintly cheese-like in its flavor. Due to its characteristically thin consistency and its sour almost cheese-like flavor it's a good substitute for buttermilk.
28. **Probiotic lemonade**: prepared from the fermentation of lemon juice, sugar or sucanat, whey, and filtered water.
29. **Rejuvelac**: a non-alcoholic fermented liquid made from sprouted grains. Because it is fermented, Rejuvelac contains beneficial bacteria and active enzymes, and thus it is reported to improve digestion of food. Rejuvelac can be drunk as a digestive aid or used as a starter culture for other fermented foods such as raw nut and seed yoghurts, cheeses, sauces and Essene Breads. Rejuvelac is prepared using whole wheat, oats, rye, quinoa, barley, millet, buckwheat, rice and other types of grain.
30. **Root beer**: the product of the fermentation of dried plant materials eg. sassafras root bark, liquorice root, burdock root with granulated sugar, water and dried ale or bread yeast.
31. **Ryazhenka**: is a traditional Ukrainian fermented milk product popular throughout Eastern Europe. It is a variety of yogurt which is made from baked milk by lactic acid fermentation using *Streptococcus thermophilus* and *Lactobacillus delbrueckii subsp. bulgaricus* bacteria cultures.
32. **Salgam**: is a popular beverage of southern Turkey, originating from Adana. Although its Turkish name şalgam suyu (or shortened, şalgam) does literally mean "turnip juice", it is, in fact, the juice of purple carrot pickles, heavily salted, spiced and flavoured with aromatic turnip (çelem) and fermented in

barrels. It is traditionally served cold in large glasses with long slices of pickled carrots, called tane**.**

33. **Skyr**: is an Icelandic cultured dairy product, similar to strained yogurt. It has been a part of Icelandic cuisine for over a thousand years.[1] It is traditionally served cold with milk and a topping of sugar. In its traditional use, it was diluted with water when used as a beverage, or mixed with milk and crumbs of flat-bread as a quick meal.
34. **Sweet potato fly**: is a lacto-fermented sweet potato beverage.
35. **Tette milk**: is produced by steeping the leaves of a blue-flowered Scandinavian meadow plant in freshly drawn milk. The milk would then sit at room temperature until clabbered, and this herbaceous clabbered milk could then be used to culture more milk.
36. **Viili**: is a yogurt-like mesophilic fermented milk that originated in the Nordic countries. This cultured milk product is the result of microbial action of lactic acid bacteria (LAB). The bacteria strains used in its production produce exopolysaccharides which gives viili a ropey, gelatinous consistency and a pleasantly mild taste resulting from lactic acid.
37. **Water kefir**: like kombucha, is first cultured by introducing a SCOBY (symbiotic culture of bacteria and yeasts) into sugar water.
38. **Bulgarian buttermilk**: is a version of cultured buttermilk in which the cream cultures are supplemented or replaced by yogurt cultures and fermented at higher temperatures for higher acidity. It can be more tart and thicker than cultured buttermilk.
39. **Fermented fruit juice**: is produced from the fermentation of fresh fruit juice eg apple, pineapple or pear, kefir grains or whey, water and salt (optional).
40. **Ginger kombucha**: NAFB, ingredients : water, white sugar, black tea, green tea, per-made unflavoured kombucha, scoby, fresh ginger.
41. **Orange fennel kombucha or Tibicos**: first we have to produce kombucha or water kefir (this is the first fermentation) and then we have to ferment fennel seeds, dried orange peel, candied minced ginger pieces with kombucha or water kefir (second fermentation).
42. **Orange Hibiscus ginger kombucha**: first we have to produce kombucha or water kefir (this is the first fermentation) and then we have to ferment dried

orange peel, dried or fresh ginger root, Hibiscus flower with kombucha or water kefir (second fermentation).

43. **Turkish tea**: All tea is produced from the same plant, *Camellia Sinensis*; it is the amount of fermentation that determines whether the tea turns out to be black, oolong (semi-fermented) or green (unfermented). A unique feature of Turkish tea is that no chemical substances or additives are used in the production process.
44. **Vino** : low alcohol wine, from the fermentation of rice.
45. **Water kefir grain soda**: is a lacto-fermented soda, produced from the fermentation of water kefir grains, mineral rich water, for example spring water, and sugar or barley malt or sorghum syrup or molasses.

iv. Table of examples of the visitors' on-line comments

COMMENTS OF THE VISITORS		
HEALTH		
Benefits	**Digestive issues**	**Side effects**
• Good liver function • Liver cleansing properties • Effect on candida overgrowth • Good for people who are dairy-free • Good for people allergic to milk protein • Cured constipation and intestine • Good for vegans • Good for stomach discomfort • Maybe cleans the body, regulates blood sugar and lowers BP • I have erosive gastritis. Do you think that kefir would help me with this issue? • Kombucha is a medicinial tonic. • Does store bought kefir has the same benefits with homemade kefir? • Are the health benefits basically the same for Jun tea	• How much is the portion for beginners and for kids • Kombucha promotes healthy digestion by repopulating the digestive tract with good bacteria	• I get so much air in the stomach when I drink kefir • I heard that carbonation is bad for your bones • Will the antimicrobial properties of honey affect the microbial process of fermentation? • I made my own, but drinking it gave me the kind of headache I get from cheap red wine. Has anyone else had this problem? Or know why I might be having it? • Has anyone heard of a reaction of kombucha after months of drinking it, like a rash only on the neck which is itchy, dry, peels?

as they are for kombucha?			
ORGANOLEPTIC CHARACTERISTICS			
Taste	**Flavor**	**Color**	**Texture**
• Sweeter than milk • Personal opinions about other tasted fermented products • Different recipes for kids and tastes they love • Some ingredients used in fermentation alter the taste • Taste and memories • Impressions after tasting the product (eg. Kombucha tasted like vinegar) • Maybe tastes like a sparkling beverage • Slightly prudent taste and was still very thin • If you don't like the flavor of the kefir, you can use yeast. My brewer recommended champagne yeast. It will taste more like what you are used to buying at the store but the roots will be more flavorful.	• Recipes for different flavors • Commercial Vs Natural flavorings	• I do brew full strength but some of the color seems to settle during the brewing process	• When I tried to prepare kefir at home the final product was too thick. Why do you think this happened? Do I have to change anything in the recipe or in the preparation methods?

METHODOLOGY		
Preparation		**Preservation**
• Time of fermentation • Temperature while brewing • Different recipies-sharing family recipies with other people • Recipies for kids • Eliminating or substituting some ingredients, (tap or **spring** water?)- (sugar or agave nectar?)- (white coconut sugar ore marple?)-(canned or homemade coconut milk?)-(cinnamon or nutmeg in kefir?, even ginger are nice additions and can musk the sharp flavor)- before or after the fermentation added? • Can *Kombucha* be used as a starter • How do you do a second fermentation? • Should the jar be sealed? • Size of the jar container • Problems with carbonation (no carbonation) • Should I let it ferment for longer in order to lessen the sugar content?		• Can be frozen and then thawed and used? • Best consumed before • Storage information • Cleansing of the storage equipment • Do kefir grains ever go bad?
NUTRITIONAL FEATURES		
Nutritional content	**Alcoholic content**	**Caffeine content**
• Do you know how many sugar calories there are after fermentation? • How much carbs are in the near beer? How does it affect your blood	• Is the final product alcoholic due to the yeast?	• Kombucha has low amount of caffeine

sugar? • How should the recommended daily intake for kefir could be? • What is the nutrient profile of Jun? • Milk kefir grains have more probiotic than water kefir grains • How many probiotics would you say is in this recipe? • Some ingredients used in fermentation alter nutrient content		

MODES OF PREPARATION AND CONSUMPTION	
In different countries	**Variants of specific beverages**
• Maybe was my favorite refreshing drink in Trinidad • I went to Japan and tried Kombucha on a number of occasions. • This is a fantastic recipe. It takes me back to my childhood in England • While living and traveling with	• I currently fermenting water kefir, sauerkraut, kimchi and pickles • I thought I hated kombucha before I started brewing it myself, because the bottled versions are so vinegary and intense. I started making it myself just out of curiosity and interest in various fermented food/drinks, and now I love it! Homemade is delicious, and you can make it as sweet or as strong as you like just by adjusting the brewing time.

the Bedouin of Egypt our camels' milk was re-cycled through bladder's tied to humps, saddles, slung over shoulders, gently rocking and swaying throughout the days into star filled nights. This ever available beverage remains impregnated within organs and inner lining, and as far as I know the cultures' within are as continuously old as a thousand caravans passing through generations, each giving birth and moving on since time-and-memorial! Caravans of yak-and-camel, goat-and-pony crossing steps, spanning deserts, passing through forests, over mountains and tossing oceans, always destine to places never before heard of, for generations unseen. These growing colonies evoke such images and answer such questions as; From where, and from when did this wonderfully tangy-and-tasty treat originate and is it the same in variety and character as human cultures? Does it vary as greatly as do we, in its taste and colonial heritage… Kefir is an undying treat from pantry shelf to village hut and outward bound	

into a sea of culinary possibilities! Anthropologist, Caril Ridley • Hi Jenny, This looks great; thanks for sharing it! I live in the bush in central Canada, where we have a number of root-beer ingredients growing wild. • I like to drink the kombucha when it's fresh, fizzy and room temp from a fresh brew before its put in the fridge, so this is exactly what I was looking for. My sister in law is from Kazakhstan and grew up with a jug of kvass on her counter. And they never refrigerated it. I wondered how.		
PROHIBITIONS		
Alcohol content	**Tea content**	
• I don't drink alcohol for religious reasons. Is kefir safe for me?	• I don't drink tea for religious reasons. Is there a way to make water kefir continuously?	
ECO-GASTRONOMY		
Food waste	**Cost**	**Variations of use in different cultures**
• What can we do with the	• Prices	• Other uses e.g. fermented

perishable ingredients • Nothing is wasted • Collect the whey and use it later-keep it in the fridge • Can the grains be re-used	• Milk *kefir* grains are reusable so inexpensive • How many times can kefir grains be re-used?	juices → popsicles
RECOMMENDATIONS		
Safety	**Suitability for special groups**	
• For infants and kids • During pregnancy – negative effects of ginger in pregnancy • Safe amounts for kids (for milk kefir) • Is it safe for my husband who suffers from lymphoma? (since it contains sugar and sugar feeds the cancer) • Is it safe while nursing? • A white substance floating on the top of the liquid • Is it mold or milk solid? • Is it safe to drink? • Fermented milks: Because they are so much easier to digest, even babies can eat cultured milk products like yogurt and cottage cheese (from about 7 months) • Is there a risk for botulism	• Are they suitable for weight losers? • Do they contain a lot of sugar? • Athletes drink *beet kvass* for performance enhancement • How often should an adult drink this / week? Children? • Can I drink Jun tea while pregnant? • Is kefir suitable for lacto-vegetarian?	

through using honey to ferment tea?		
NOVER VERSIONS		
Different versions	**Substitutions of ingredients in recipes**	**Culinary uses**
• Healthier versions of recipes, e.g. low fat – low sugar – low salt version • Lactose tolerance versions • Caffeine free versions • I' m substituting agave nectar for the sugar, it is more diabetic friendly	• Can it be a substitute for raw milk in order to make a baby formula?	• *Beet kvass* can be used not only as a beverage but also as a salad dressing
PROCUREMENT		
Stores	**Sites/blogs**	**Online groups**
• Where do we buy cultures and starters? • Info about people willing to share culture "babies" for free • Can I get the coconut water kefir at a healthy store locally? • Does anyone in Europe have Jun Mother (culture)? • Organic groceries	• I've been searching for a kombucha that I can stand. So glad I've found http://fabulousferments.com/ in Cincinnati, Ohio. I love kombucha now! Too scared to make my own. Check out this new possible wardrobe material - yes kombucha. Very funny! Not for	• Proposed groups for brewers? • Very much want to be in a group to learn more. I am already in the LinkedIn Kombucha group • Is there a Facebook group for fermenters? • A group in Facebook called wild fermentation (there is a group of people who can share kefir grains) • HI Kim ~ Scobies can be obtained online pretty easily,

	bathing suits:) http://www.ted.com/talks/suzanne_lee_grow_your_own_clothes.html • I've been making my own Kombucha for about a year now from a scoby given to me by a woman who was blogging about it. • Yes they do!! I also put some on my amazon store that are a little cheaper, maybe you can get free shipping too!!	just do a google search. Or ask around you local community through your health food store that may already carry kombucha. there is also an online group that you can get a scoby for free but just have to pay shipping. Here's one link to check out;
MARKETING INFORMATION		
Brand names	**Special characteristics**	
• Recommendations of brands (eg. KeVita for coconut water kefir) • Different names of the product in different countries or regions or different recipies	• Refreshing	