Consumer Attitudes, Market Potential and Microbiological Analysis of Kefir: Implication for Dairy Product Diversification in Ethiopia

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Abstract: This study was conducted to explore consumers' attitudes and market potential for a fermented dairy product-kefir. It was also intended to produce experimental kefir and undertake nutritional, microbial, texture and viscosity analyses as well as sensory quality evaluation. In order to meet the objectives, a direct questionnaire survey involving 743 respondents from seven major cities in Ethiopia was performed. The results revealed that the respondents indicated very high interest in kefir and are willing to purchase in case of availability in the market suggesting existence of an opportunity for dairy processing industries in Ethiopia to introduce kefir to the market and meeting the increasing demand for diversified dairy products in urban areas. In an attempt to meet the second objective, experimental kefir was produced under laboratory scale at the Food Engineering Laboratory of Addis Ababa Institute of Technology, Addis Ababa University and then after the end product was analyzed for proximate chemical composition, microbes, texture and viscosity. Added to this, evaluation for sensory qualities by panelists selected from consumers group and people who are familiar with quality attributes of dairy products was performed. The results revealed that kefir can be processed with the existing technologies in the Ethiopian context and has good nutritional composition and the processing technology provided microbiologically non-hazardous end product.

Keywords: Consumer Attitudes; Dairy Diversification; Kefir; Market Potential; Microbiological Analysis

1. Introduction

The demand for milk and milk products is increasing in Ethiopia as a result of rapidly increasing population size with a growing urban population (Ahmed *et al*., 2004; SNV, 2008). Similar studies indicated that the raise in demand together with technological intervention and policy reform gave an impetus for the dairy sector in Ethiopia to achieve a considerable progress over the last decades. Notwithstanding the positive developments and expected growth of dairy sector in Ethiopia, however, the value chain for milk is still very weak. The dairy processing industries in the country have been engaged in producing limited types of products such as pasteurized milk, yoghurt, limited varieties of cheese and butter.

In order to meet the rising consumer demand, product identification, design and development of diversified dairy products that can easily enter into the market need special attention (Land O'Lakes, 2006). The commencement of more demand driven diversified dairy products will help in partially closing the gap between supply and demand in urban areas. It will also help reduce fluctuation in consumption patterns and price during the fasting and non-fasting periods and ensure products availability throughout the seasons. However, developing and offering new diversified dairy products to the market should be preceded by consumer survey in view that the production and marketing strategies of any product are primarily determined by consumer beliefs, attitudes, responses to products and their willingness to pay for it (Hoyer and MacInnis, 2004). Moreover, it is natural that consumers buy products that will best meet their needs, as well as fit to their lifestyle. Thus gathering and evaluation of data regarding consumers' reaction to the basic idea of the product prior to its introduction is helpful in determining market potential and making decisions such as pass/fail or go/no go.

Kefir is a traditional fermented dairy product originated from the tribes of the Northern Caucasus mountain region in Russia, obtained by incubating goats, sheep or cow's milk with the microflora of *kefir grains* (Robert, 2006). *Kefir grains* are small bodies of some 1-3 cm in diameter, and the outer surfaces are highly contorted. They are a mass of several different bacteria and yeasts imbedded in a complex matrix of protein and carbohydrate. *Kefir grains* are very complex and the grains are composed of mixture of micro-organisms and the groupings held together in highly organized pattern (Figure 1). The peripheral layers of the granules are dominated by various rod shaped bacteria. But towards the center, yeasts become the major component organisms, and yet the granules freely proliferate in milk with almost no changes in character (Tamime, 1983). The main capsular polysaccharide, named kefiran, is produced by *Lactobacillus kefiranofaciens*. Kefiran is a branched polysaccharide containing equal amount glucose and galactose. It can be extracted from kefir grains with hot

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ISSN 1992-0407

water. In solution, kefiran causes only a small increase in viscosity. Generally, *kefir grains* are complex communities of microorganisms which arose from physical association of about 30 species of bacteria and yeasts. The bacteria, yeasts, polysaccharides, and proteins in kefir grains added to milk produce kefir. By and large, kefir is produced by adding either a starter culture called *kefir grains* directly or a percolate of the grains to milk. *Kefir grains* are a mass of several different bacteria and yeasts imbedded in a complex matrix of protein and carbohydrate. Kefir is known for its superb health benefits including, balancing the levels of bacteria in the intestinal tract thereby preventing infections, boosting the immune system, easing digestion, especially for those with lactose intolerance, controlling cholesterol levels, and maintaining heart health (Otes and Cagindi, 2003). Easily digested, kefir cleanses the intestines, provides beneficial bacteria and yeast, vitamins and minerals, and complete proteins. Because kefir is such a balanced and nourishing food, it contributes to a healthy immune system and has been used to help patients suffering from AIDS, chronic fatigue syndrome, herpes, and cancer (Gill, 1998). Its tranquilizing effect on the nervous system benefits people who suffer from sleep disorders, depression, and ADHD (attention deficit hyperactivity disorder). The regular use of kefir can help relieve all intestinal disorders, promote bowel movement, reduce flatulence and create a healthier digestive system. In addition, its cleansing effect on the whole body helps to establish a balanced inner ecosystem for optimum health and longevity. Kefir can also help eliminate unhealthy food cravings by making the body more nourished and balanced (Cevikbas *et al*., 1994). Kefir has variously been described as a 'dairy champagne', 'the champagne of cultured dairy products' and 'yoghurt of the 21st century' (Ouwehand and Salminen, 1998).

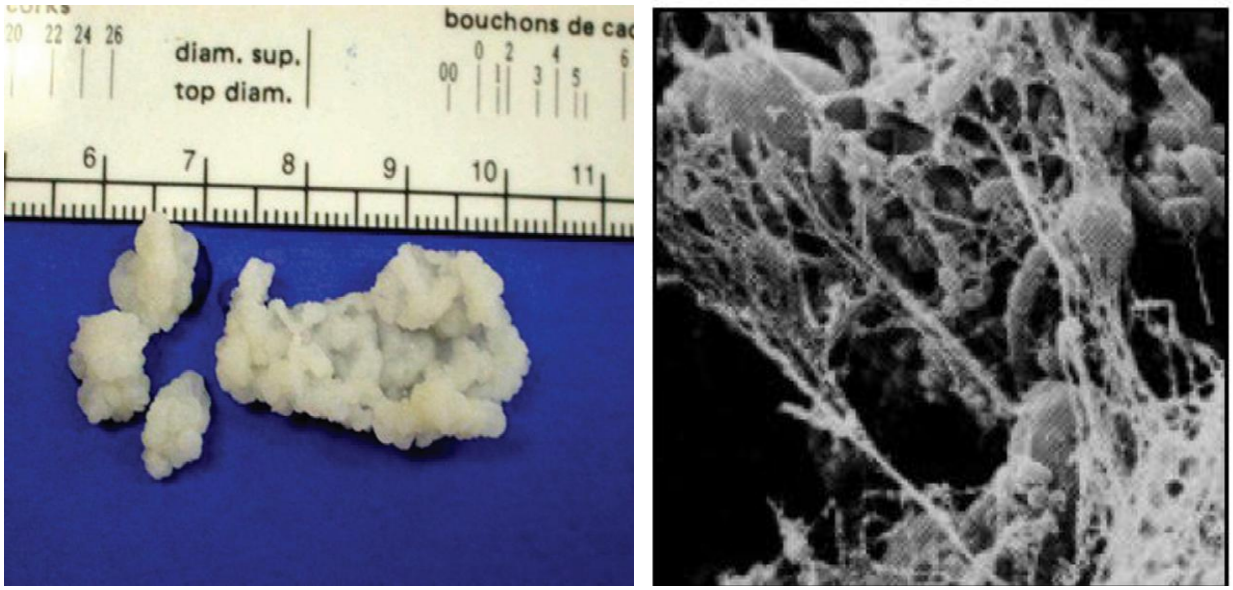

Figure1. Electron micrograph of kefir grains.

The consumer's interest in fermented milk products is gaining momentum due to the development of new food processing techniques, changing social attitudes; scientific evidence of health benefits of certain ingredients (Stanton *et al*., 2001). This study is part of a research project entitled "Design and Development of Dairy Products Diversification in Ethiopia" funded by SNV (Netherlands Development Organization), BOAM (Business Organizations and their Access to Markets) Program, Dairy Development Value Chain.

The aim of the present work was, therefore, to understand purchasing habits and consumption profile of consumers and explore consumers' attitudes and market potential for kefir in major cities of Ethiopia. The study involved in design and development of kefir at small scale industry and undertakes nutritional, microbiological, texture, pH and viscosity analyses in order to determine the possibilities of producing kefir in Ethiopia with the existing technology. Additionally, sensory quality evaluation analyses of kefir product to determine attributes in order to drive consumer preferences prior to the large scale production and introduction of the end product to the market.

2. Materials and Methods

2.1. Survey Study

The survey was carried out from September 2009 to April 2010 by using structured interview questionnaire. The survey data (demographics of the respondents, purchasing habits and consumption profile, market potential for kefir and packaging preferences) were collected from 743 respondents in seven major cities in Ethiopia, namely; Addis Ababa, Debrezeit, Adama, Hawasa, Dire Dewa, Bahirdar, Gonder and Mekelle.

Consumers buying dairy products in supermarkets, mini-markets, kiosks, groceries, small and large shops during the survey period without any pre-selection criteria were part of the study. Due to the fact that kefir is new to the respondents, a leaflet describing about its characteristic features and benefits was included in the survey to make respondents aware of it. After having read the leaflet, respondents were asked about their overall reaction (feeling) and interest to purchase, willingness to pay, packaging preference, and the relative importance of different factors that they consider for purchasing kefir. The data collected from representative samples were descriptively analyzed using SPSS version 11.0 and the results of the analysis are presented in terms of figures, table of frequency counts and percentages.

2.2. Experimental Materials

The basic raw materials for kefir production were cow's milk, starter culture, dairy ingredients, and packaging materials. In kefir processing, many processing unit operation were used. The unit operations/instruments used for kefir processing and quality control includes fermenter (bioreactor), incubator, sterilizer, milk pasteurization unit, autoclave, texture analyzer, visco-analyzer and other milk processing apparatus. The dairy ingredient specifically the kefir culture was obtained from CHR.HANSEN (Denmark). The kefir grains were presented in form of freeze-dried culture for direct inoculation of milk.

2.3. Chemicals and Reagents

Most chemicals and reagents for nutritional composition, minerals and microbiological analyses were supplied by Aldrich Chemical Co. Inc.(Milwaukee, WI,USA) and Sigma Chemical Co.(St.Louis, MO,USA) through local suppliers. All chemicals and reagents used were either analytical or reagent grade.

2.4. Experimental Processing Technology in Kefir Production

The essential ingredients for kefir processing were prepared and stored with the required temperature ranges (-15 to -18 ^{o}C). The equipments used for kefir production were fermenter (Bioreactor), steam generator, sterilizer/pasteurizer, packaging unit, incubator and autoclave. The kefir culture was stored at -18 ^{o}C and then the sachet kept at room temperature for one hour before opening. The kefir grains purchased from CHR.HANSEN (Denmark) were whipped at the top with disinfecting solution (70 % ethyl alcohol) and cut at the top of the sachet.

To reduce bacteriophage infection, spatula, milk pails, milk cans, beakers, measuring cylinder, funnel and scissors were sterilized using Amestel sterilizer at 121 ^{o}C for 30 minutes (SAno clav, Italy, 2006). Initially, the fermenter was sterilized at 121 ^{o}C using steam. The capacity of the fermenter is 40 liters and the culture added to the manufacturing milk (40 liters) as soon as the agitation blades of the fermenter were covered with milk. Foam and air introduction into the milk were avoided, and the required amount (3%) of the kefir starter culture for 40 liters of milk was calculated and weighed with balance (Explore Pro. Model EP214C, Switzerland, 2007) using sterilized beaker to maintain the safety of the kefir starter culture.

Kefir was produced at Addis Ababa University, Food Process Engineering Laboratory according to standard method used by Tamime *et al.* (1999). Standardized whole milk from Lame dairy located at Addis Ababa was purchased and heated to 95 ^{0}C with holding time of 30 minutes using bioreactor (Figure 2). The milk was then cooled to 23 ^{0}C and inoculated with 3% kefir culture. The product was incubated (22°C/14h), and then subjected to ripening/maturation (8°C/12-14 h) until the pH value reaches to 4.3. The end product kefir was stored at 4°C and the nutritional composition, microbial, texture, and viscosity analyses as well as evaluation for sensory parameters were conducted.

Figure 2. Fermenter (40l, Bioengineering, England, 2005)

2.5. Analyses Methods

2.5.1. Proximate Composition Analysis

The official standard methods of analysis of Association of Official Analytical Chemists (AOAC, 2009) were used for physico-chemical and proximate chemical analysis of kefir. Moisture, total ash, crude protein, crude fiber, and crude fat of the seed flours will be determined according to AOAC (2009) using the official methods 925.09, 923.03, 979.09, 962.09, 4.5.01; respectively. All the minerals except phosphorus were analyzed from triple acid digested samples using atomic absorption spectrophotometer (Hitachi, Model Z-8230, Japan) according to the method of Isaac and Johnson (1975). Phosphorus content was determined colorimetrically (Dickman & Bray, 1940) using UV/Visible spectrophotometer (Model 6405, Jenway LTD.UK, 1999). The pH values of kefir were determined using a pH meter (HANNA Instruments, H301, Portugal), AOAC official method. The viscosity of kefir was measured using Vibro Visco-analyser (Figure 3) at the Food Engineering Laboratory of Addis Ababa University.

Figure 3. Vibro Viscometer (Model SV-10, Switzerland, 2007)

The texture profile of kefir was measured according to the method described by Bezaye *et al.* (2012) with a LLOYDЖ, TA plus Ametek, UK, 2007, texture analyzer (Figure 4). The category of test used for texture (stiffness) was general-purpose compression set up with compress to limit test type. The maximum compression force was measured and recorded at a crosshead speed of 15 N min^{-1}. The stiffness of kefir was expressed as the maximum compression force per meter of sample (N m^{-1} kefir sample). Values were reported as the means of triplicate determination.

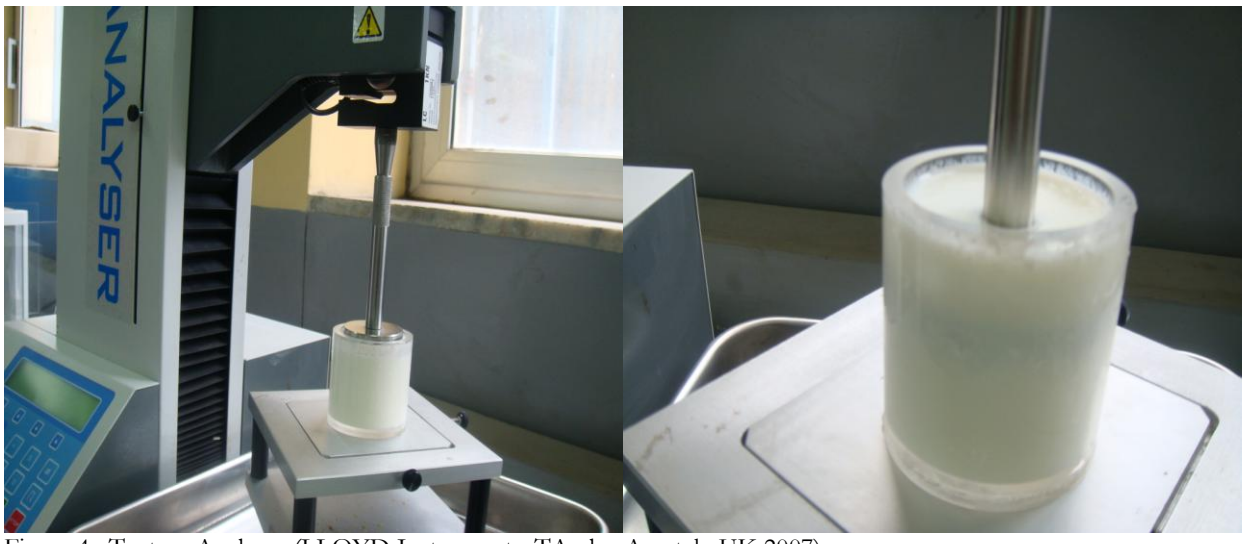

Figure 4. Texture Analyzer (LLOYD Instruments, TA plus Ametek, UK 2007).

2.5.2. Microbiological Analysis

Microbiological analyses in kefir and yoghurt samples were evaluated using a standard method described by Sharma (2006). Mold, yeast, total coliform, fecal coliform, aerobic bacterial plate count, *E.coli* count, *S.aureus* count, *B.cereus*, salmonella and *shigella spp* were performed using standard methods.

2.5.3. Sensory Quality Evaluation of Kefir Using Hedonic Test

Sensory analysis are conducted to better understand attributes of a product that drive consumer preferences and consequently enable processors to optimize a product's attributes to attract specific target audiences as well as accurately monitor product quality. In view of this a sensory evaluation was carried out by panelists selected from consumers group and people who are familiar with quality attributes of dairy products.

The sensory quality evaluation was conducted using a 5-point hedonic scale adapted from Resurreccion (1998) which is suitable for consumer sensory testing for product development. The processed kefir samples were presented alongside with the hedonic test form. The twenty five panelists after providing orientation were asked to rate each sensory attributes employed in the evaluation of the sensory quality of kefir such as color, appearance, taste, after taste, flavor (taste + odor), aroma, consistency, acidity and overall acceptability on 5-pointhdonic scale; where: 1 = dislike extremely, 2 = dislike moderately, 3 = neither like nor dislike 4 = like moderately and 5 = like extremely.

2.6. Statistical Analysis

Data were subjected to analysis of variance (ANOVA). Where the ANOVA test indicated significant differences and treatment means were separated using Duncan's multiple range test at 5% probability level.

3. Results and Discussion

3.1. Results of Consumers Survey

3.1.1. Demographics of Respondents

The sample population used in this study consisted of 743 people aged between 18 and 76, being 57 % female and 43% male shoppers. With respect to the educational level, 21% had attended non-formal education or only completed their primary education, 35% had completed secondary education and 44% had attended College/University education. This proportionality could be explained by the greater frequency of women shopping for food products and the tendency of better educated towards the consumption of dairy products. In addition, the sample comprises people earning gross monthly salary greater than 3000 Birr (65%), which in turn might be associated with the level of education. Moreover, a great majority of the respondents (nearly 64%) were Orthodox Christians, while the remaining constitutes other Christians (19%) and Muslims (16%).

3.1.2. Consumers' Reaction and Purchase Intention for Kefir

A consumer's reaction plays a key role in determining his or her affection for a product and the intention to make purchase in case of product availability (Lai *et al.*, 2005). Such feelings towards a product can result from a given product related information or experience whether perceived or real. This implies the meaningfulness of measuring feelings towards a product that a consumer has never used (Smith and Albaum, 2007). In view of that, respondents' overall reaction to kefir based on the explanation and description in the leaflet was measured using ordinal scale across 5 points, ranging from excellent to poor. As presented in Figure 5 respondents' reaction to kefir shows that 38% of the respondents have rated kefir as excellent. Similarly, significant percentage of the respondents found the described product very good (31%), good (18%), fair (9%) and poor (4%). In general, this result indicated that kefir has received a positive reaction from the significant majority of the respondents. In addition, asked about which characteristics of kefir they most liked, most respondents said it is good for health and has the capacity of protecting and also curing some diseases.

Respondents were then asked to indicate their purchase intention if kefir is available in the market place measured using ordinal scale across 5 points, ranging from very interested to very uninterested. As is presented in Figure 6, the study result showed that 88.4% of the respondents reported that they are either very interested or interested to buy kefir and they would be among the first to try the product if available for purchase. Of the remaining, while 6.6% are neutral, 5% are either uninterested or very uninterested to purchase kefir in case of its availability in the market. In general, the study result indicates that kefir is of great interest to respondents. Moreover, no significant differences were seen between different income groups as well as respondents in different cities in terms of their interest to purchase kefir if the product appears as it is described in the leaflet. However, the results did show a slight difference between different age groups in which younger respondents have shown somewhat stronger interest towards purchase of kefir than respondents of age above 45 years.

Figure 5. Respondents' reaction to kefir.

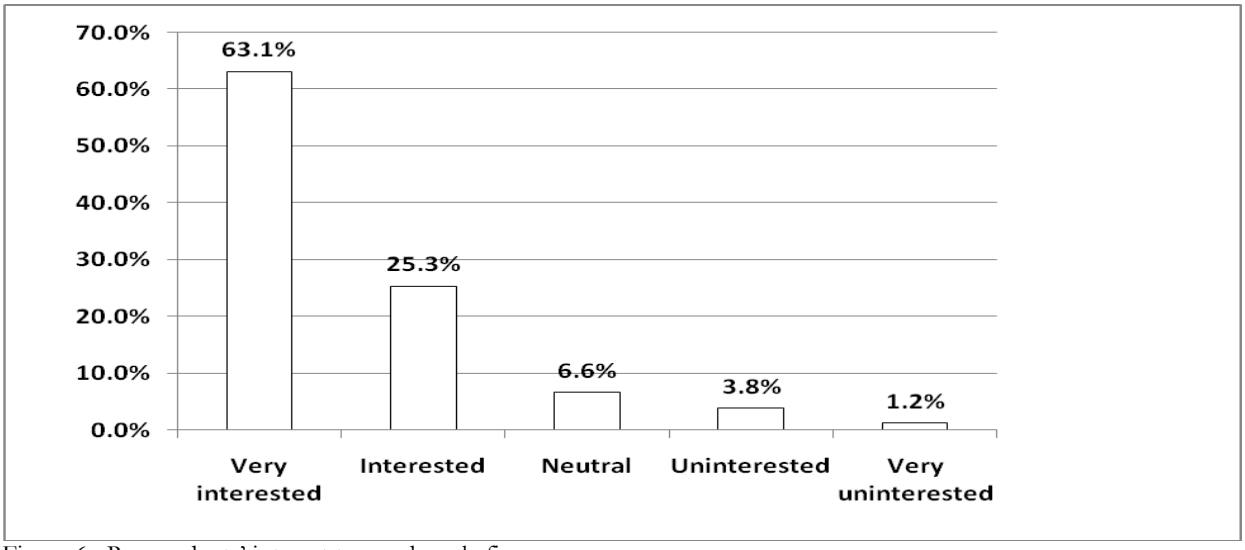

Figure 6. Respondents' interest to purchase kefir.

3.1.3. Packaging Preference

The consumer's first contact with a packaged product is often the key factor in the purchasing decision because the buyer's perception of product packaging may substantially influence his/her decision to purchase a given item (Staniewska *et al*., 2008). Nickels and Jolson (1976) reported that packaging design plays a crucial role in communicating with the consumers. According to these researchers, package holds information about product attributes in written form i.e. factual information about the ingredients, nutritional value, shelf life, volume, of the product. Beyond that packaging communicates impressions of brand personality. Holding communication of the factual information constant, "unit packaging, size, shape and graphic design, and the materials from which the package is made are often regarded as an integral part of the product" (Staniewska *et al*., 2008). This implies that different packaging materials may result in very different consumer perceptions of the products attributes. Thus, it is up to the consumer to decide in what packaging the product will conquer the market. In view of this, therefore, respondents were asked about which packaging material applies best or that they prefer for kefir.

Table 1 provides information on respondents' preference of packaging material. The result showed that cup container is the most preferred packaging material by a significant majority of the respondents (nearly 60%) followed by flexible (sachet) packaging which is favored by 18.2% of the respondents. On the other hand, 13.7% and 8.3% of the respondents have chosen glass materials and carton materials respectively. Main reasons

respondents gave for preferring cup as container include convenience, easier to open and/or re-close, more pleasant to handle and to touch, making the products look more attractive, and ease out of home consumption are some of the major reasons given for preferring cup packaging. Further, consumers have pointed out that although glass has the most outspoken image of all packaging types: classy and with a good preservation of taste and also environmentally friendly. However, glass packaging may not always be available on store shelves or makes products' price unaffordable. Price is found to be the main reason given for choosing carton and flexible packaging.

The cross tabulation presented in Table 2 that considers age of the respondents and their packaging material preference indicates that respondents packaging preference moderately correlated to the respondents' age. As can be seen in Table 2, out of those respondents who preferred cups, the vast majority are below age of 45 years, while most respondents of age above 45 have inclined to flexible packaging, glass, and carton. This reveals that young consumers are the best fans for cups packaging. The result generally indicates that using age-friendly packaging materials and design for kefir and making it available in different packaging materials would allow consumers to choose their preferred packaging.

Table 1. Packaging preference of consumers (N=743).

Packaging Type	Percentage (%)
Carton(Paper Board)	8.3
Cup	59.8
Flexible Package	18.2
Glass	13.7

Table 2. Age of the Respondents * Packaging Preference of Respondents Cross-tabulation.

		Packaging Preference of the Respondents'				
		Flexible Package	Glass	Cup	Carton	Total
Age of the Respondents	18-26	11	6	118	5	140
	27-35	27	13	187	10	237
	36-45	31	40	110	19	200
	46-55	42	25	16	14	97
	56-65	23	18	11	15	67
	+65	1		1		2
Total		135	102	443	63	743

3.1.4. Willingness to Pay for the Product

Estimating consumer's willingness-to-pay provides information to decision makers regarding the potential benefits and costs associated with a particular product. Typically, this involves eliciting willingness of consumer's to pay for a particular product which provides a marginal value for that decision. In view of this, we asked respondents to indicate whether they are willing to pay more or less than the average price indicated for 150 ml kefir presented in cup. The indicated average prices have been determined taking into consideration, the estimated default production costs, the current market price of related products, technology to be employed, market potential for new products, and the consumer's ability to pay.

Figure 7 shows that in case of product availability, more than half of the respondents (51.7%) indicated that they are willing to pay more if they knew that the price of kefir 150 ml cup is 7.50 Birr, while the remaining 48.3% are willing to pay less. A significant difference has been observed between different income groups in terms of their willingness to pay for the product. Compared to the low-income group, the middle and high-income groups are willing to pay more than the indicated average price. This indicates that producers can charge a relatively higher price at first, and then lower the price over time. In fact, this depends on the objectives of the producer. For example, with the objective of securing a large share of the market (market penetration), the producers can deliberately set low prices from the beginning in view that the unit cost of production and distribution will decrease when the volume of sales attains a particular target. Thus, it is necessary that the producers decide the objective of pricing before actually setting price for kefir.

3.1.5. Factor that Consumers Consider Most Important for Purchasing Kefir

Many factors can influence the need states of consumers and how consumers choose among competing offerings to satisfy those needs (Ndubisi and Funk, 2004). Most importantly, factors that influence perceptions about dairy products may be more likely to affect the decision to participate in dairy product consumption as well as the quantity to be purchased (Fuller *et al.* 2006). In order to

identify factors that consumers consider for purchasing kefir more at a time or more frequently, respondents were asked to rate the degree of importance they attach to several factors on ordinal scale of very important to not important at all. Then, mean is calculated using values of 5 very important through 1 not important at all indicating that a high mean shows the most important factor. Obviously, a low standard deviation indicates that the data points tend to be very close to the mean, whereas high standard deviation indicates that the data are spread out over a large range of values.

As depicted in Table 3, the mean score of consumers' rating on different factors ranges from 1.63 to 4.76. Overall, the factors can be classified into three categories which can be expressed in terms of high, moderate and low impact based on the rate of responses given. Accordingly, good for health ($\overline{x}$ = 4.76, δ = 0.90), hygienic/better packaged ($\overline{x}$ = 4.62, δ = 1.09), affordability ($\overline{x}$ = 4.50, δ = 1. 26), nutritious value ($\overline{x}$ = 4.36, δ = 0.91), and shelf life of the product ($\overline{x}$ = 4.33, δ = 1.02) are considered to be the most crucial factors. While appealing availability ($\overline{x}$ = 3.60, δ = 0.70), package ($\overline{x}$ = 3.18, δ = 1.09) and friends advice/recommendation ($\overline{x}$ = 3.03, δ = 0.86) are moderate impact factors, the remaining factors are found to be comparably less impact factors, of which more fat content is the least one. This generally implies that in producing and selling kefir, emphasis should be given to all factors but special emphasis needs to be given to those factors to which respondents placed high degree of importance.

3.2. Proximate Composition, Microbiological, Texture and Viscosity Analyses and Sensory Evaluation

The proximate composition result presented in Table 4 shows that kefir consists of crude protein, crude fat, crude fiber, moisture and ash; 3.41, 2.70, 0.52, 87.43 and 0.67%, respectively. Kefir also consists of Ca and the seriously limited mineral (Zn) in East Africa; 122.92 and 0.35 mg/100gm; respectively. Calcium is very important mineral in kefir which is used in bone development for growing kids. Furthermore, zinc is an essential trace element (micronutrient) involved in the immune function, in the activation of many enzymes, healthy growth and reproduction (Shimelis *et al*., 2009). The manufactured kefir composition had similar proximate composition values with research findings reported by Otes and Cagindi (2003).

The result presented in Table 5, shows that the microorganism populations in kefir were $3x10^1$ cfu/g, which is in agreement with the findings reported by other researchers (Koroleva,1982; Wszolek *et al*., 2001) and much lower than tha reported by KiliÇ *et al*., (1999); and Rea *et al*., (1996). The yeast and mould population levels, fecal coliform, *E-coli* and *S.aureus* were less than 1 x 10^1 cfu/g, which is much less than the finding of Irigoyen *et al.* (2005). The result of microbiological analysis, therefore, revealed the absences of photogenic microorganisms which can bring food borne diseases in kefir sample tested.

The experimental result on texture analysis displayed in Table 6 show that the kefir value (1.58 mPa.s) compared to the research finding of Wszolek *et al.* (2001) is higher than pasteurized milk (1.22 mPa.s) and less than set plain yogurt (2.45 mPa.s) . This indicates that kefir is similar to a milkshake or smoothie and contains microorganisms known as "probiotics." It has a wonderful smooth texture with a delightful creamy mouth-feel low resistant to flow. The pH value of kefir after incubation time of 23 hrs changed from 6.6 to 4.6 (Figure 8).

Table 3. Consumers' rating (5-points scale) on importance of product characteristics (N=743).

Product characteristics	Mean ± SD	Classification of product characteristics based on impact level
Affordability	4.50 ± 1. 26	High
Appealing package	3.18 ± 1.09	Moderate
Availability	3.60 ± 0.70	Moderate
Availability close by	2.34 ± 1.03	Low
Brand of the product	2.15 ± 1.56	Low
Contains more fat	1.63 ± 0.52	Low
Doctor's advice	2.63 ± 0.62	Low
Friend advise	3.03 ± 0.86	Moderate
Health benefits	4.76 ± 0.91	High
Hygienic/better packaged	4.62 ± 1.09	High
If fridge at home	2.07 ± 0.98	Low
Knowing how to use/consume it	2.12 ± 0.92	Low
Nutritious value	4.36 ± 0.90	High
Shelf life of the product	4.33 ± 1.02	High

Mean is calculated using values of 5 very important through 1 not important at all. Hence, a high mean indicates the most important characteristics

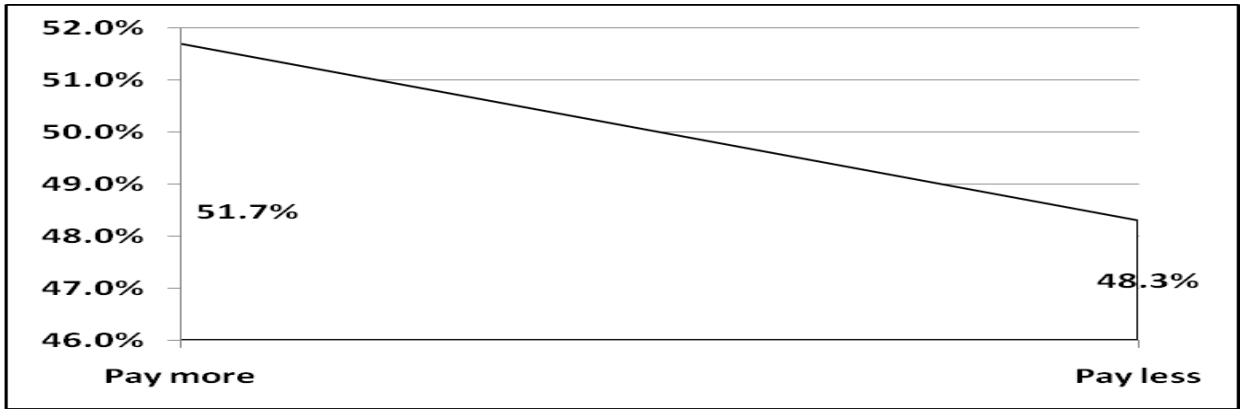

Figure 7. Willingness to pay more/less than 7.50 Birr for 150ml kefir presented in cup.

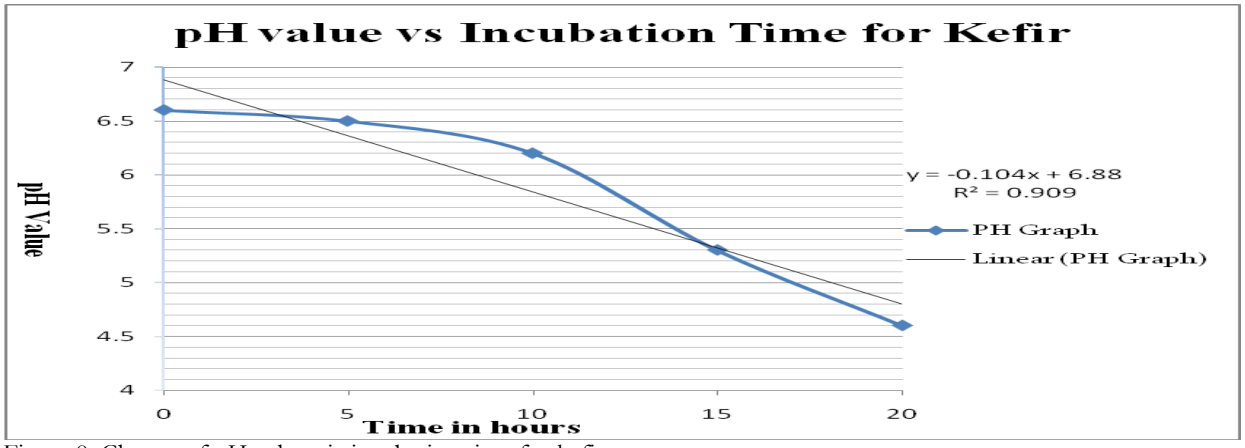

Figure 8. Change of pH value via incubation time for kefir.

Table 4. Proximate composition of kefir in terms of 100 grams edible portion.

Moisture (%)	Protein (%)	Crude fat (%)	Crude fiber (%)	Ash (%)	Ca (mg/100gm)	Zn (mg/100gm)	Fe (mg/100gm)	Cu (mg/100gm)	P (mg/100gm)
87.43	3.41	2.70	0.52	0.67	122.92	0.35	0.19	0.01	11.61

All values are means of triplicate determination.

Table 5. Microbiological analysis of kefir.

Total Coliform Count ($Cfug^{-1}$)	Mold ($Cfug^{-1}$)	Yeast ($Cfug^{-1}$)	APC ($Cfug^{-1}$)	*Fecal Coliform* ($Cfug^{-1}$)	*E-coli* ($Cfug^{-1}$)	*S.aureus* ($Cfug^{-1}$)	*B.cereus* ($Cfug^{-1}$)	*Salmonella* ($Cfug^{-1}$)	*Shigella spp* ($Cfug^{-1}$)
3×10^1	$< 1 \times 10^1$	$< 1 \times 10^1$	2×10^8	$< 1 \times 10^1$	$< 1 \times 10^1$	$< 1 \times 10^1$	Not isolated	Not isolated	Not isolated

APC-Aerobic bacteria plate count; In the count $< 1 \times 10^1$ is the standard reporting format for plates from all dilution of the sample has no colonies.

Table 6. Texture and viscosity of kefir.

Test Type for texture analysis	Speed (N/min)	Diameter of sample holder (mm)	Area (mm^2)	Height (mm)	Stiffness (N/m)	Young's Modulus (MPa)	Load at maximum load (N)	Viscosity (m.Pa.s)
Compression	15.00	50	1963.5	50	3051	0.078	0.506	1.58

3.3. Sensory Evaluation of Kefir

The result presented in Table 7 shows that the mean score of the sensory attributes used in this study ranges from 3.75 to 4.40 with the average mean score of 4.08. More specifically, appearance (4.40 ± 0.93), taste (4.12 ± 0.97), after taste (4.31 ± 1.02), texture (4.14 ± 1.08), color (4.13 ± 0.99), and overall acceptability (4.06 ± 0.99) are attributes that are rated higher by the vast majority of the panelists. The remaining attributes are rated moderately and there is no single sensory parameter that is rated below average. Some panelists have also described kefir as tasting like a cross between yogurt and champagne, while some others described it as tasting like home-made yoghurt, but more nutritious and therapeutic than yogurt as it supplies natural probiotics, protein, essential minerals, and valuable B vitamins. This result, generally, suggests that kefir made from cow's milk fits into the consumers' lifestyle so that it will be preferred by the market in case of its availability for purchase.

The flavor of plain kefir is primarily due to lactic and acetic acids, diacetyl, and acetaldehyde, produced by homofermentative and heterofermentative lactic acid bacteria. However, because kefir grains also contain yeast, in addition to lactic acid bacteria, other end-products are formed that make the finished product quite different from other cultured dairy products. This is because ethanol is produced when the yeasts ferment lactose, such that kefir can contain as much as 2% ethyl alcohol (Robert, 2006). Kefir is similar to a milkshake or smoothie and contains microorganisms known as "probiotics." These live and active cultures have been shown to restore essential intestinal flora diminished by everyday use of antibiotics to travel, stress and alcohol consumption (De Simone *et al.*, 1991). The taste of unflavored kefir has been described as "yeasty" and the terms "prickling" and "sparkling" has been used to describe the mouth feel of kefir caused by the liberation of trapped CO_2. Based on organoleptic assessment, it was observed that kefir had very good acceptabilty by gruop of panalists. The overall hedonic/organoleptic assessment in this study showed that the kefir product had good qualitative characteristics in its sensory attribites.

Table 7. Sensory quality evaluation of kefir.

Sensory attributes	Mean ± SD
Appearance	4.40 ± 0.93
Taste	4.12 ± 0.97
After taste	4.31 ± 1.02
Flavor	3.92 ± 0.96
Aroma	3.86 ± 1.24
Texture (consistency)	4.14 ± 1.08
Color	4.13 ± 0.99
Acidity	3.75 ± 1.02
Overall acceptability	4.06 ± 0.99
Grand mean	4.08 ± 1.02

Mean is calculated using values of 5 (like extremely) and 1 (dislike extremely); Hence, a high mean indicates highly rated attribute; Hedonic rating scale (1to5); Where: 1 = Dislike extremely; 2 = Dislike moderately; 3 = Neither like nor dislike 4 = Like moderately; 5 = Like extremely.

4. Conclusions

The result of analysis of survey data collected from743 respondents from major cities in Ethiopia indicated positive attitude of consumer towards kefir and high interest to purchase in case of its availability in the market place. Cup is found to be the most preferred packaging material. However, using age-friendly packaging materials and design as well as making kefir available in different packaging materials would allow consumers to choose their preferred packaging. In addition, the middle and high-income groups are willing to pay more than Birr 7.50 for 150ml kefir presented in cup. The most important factors that are considered to influence consumers' purchase decision for kefir were product's capacity to support health, the shelf-life/shelf-stability, hygienic/better packaged, affordability, as well as information on the product's nutritive value. Generally, an important conclusion that emerges from this study is that respondents gave a "go" signal for kefir. Nevertheless, the fact that a significant majority of surveyed consumers are Orthodox Christians who most likely fast 200^{+} days a year suggest that maintaining longer shelf-life of kefir can help smoothen demand fluctuation occurred during fasting period.

The results from the proximate, physico-chemical, microbiological, and texture and viscosity analyses indicate that kefir has good nutritional composition and the processing technology provided microbiologically non-hazardous end product. In addition, the results from the sensory evaluation revealed that kefir can be a potential dairy product that fit to the lifestyle of consumers and get accepted by the market if available for sale. In general, an interesting conclusion that emerges from the processing of kefir is that it can be processed

either by expansion of the existing dairy processing plant or via local dairy equipment manufacturing system in the Ethiopian context. These further suggests investors currently involved in the dairy sector can produce kefir that fit into consumers' lifestyle by pioneering technology transfer of this research output in order to capture the un-met consumer demand for safe, nutritious, affordable and branded kefir product.

5. Acknowledgments

The authors would like to express heartfelt gratitude to the Netherlands Development Organization (SNV-Ethiopia), BOAM (Business Organizations and their Access to Markets) Program, Milk Value Chain for financial support of this research. Special thanks are due to the EMPPA (Ethiopian Milk Producers and Processors Association) members for their valuable support from the inception to accomplishment of this research work.

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