

Research Article

Development of Koumiss Incorporated with Beet and Oat

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Abstract: The main goal of this study was to develop an innovative product based on food from vegetal origin (beet and oat) incorporated in a dairy product (koumiss). Raw materials were pasteurized milk, bacterial inoculum, beet and oat. Beet and oat were incorporated according to three formulations. The sensorial analysis (5 points hedonic scale) was done by a panel constituted by 30 non-trained personnel who considered the following attributes: aroma, taste, color, texture. The nutritional analysis was estimated considering the information in the Colombian table of food composition (2015 version). As a result, koumiss presented viscous texture similar to commercial koumiss. Additionally, the content of micronutrients was identified (from major to minor): riboflavin (1.7 mg), iron and zinc (both 1.2 mg), niacin (0.9 mg), thiamin (0.2 mg), vitamin A (97.5 UI) and folic acid (41.7 µg) based on 200 mL. Thus, there was an innovation in the presentation of this food product, which allowed improving their nutritional value. Finally, the developed product achieved a sensorial score of 4, which indicated its acceptance by consumers and commercial potential.

Keywords: Dairy product, food fortification, food from animal origin, food from vegetal origin, food intake, innovation

INTRODUCTION

The intake of balanced food and especially the consumption of vegetal products are essential components of a healthy diet. The regular consumption of vegetables is recommended because they contribute to achieving weight loss especially due to their nutrient content, with a remarkable fiber content and low caloric intake (Wagner *et al.*, 2016). This results in the prevention of chronic diseases, such as overweight and obesity, among others chronic diseases (Gutkoski *et al.*, 2007; Wagner *et al.*, 2016).

However, food products of vegetable origin are not popular among consumers and there is an estimated unbalance between the recommended amount of vegetables for consumption and the amount that is actually consumed. In this regard, 77.6% of men and 78.4% of women at global scale consume less than 400 g of fruits and vegetables, as recommended by the WHO (Bvenura and Sivakumar, 2017). This is related mainly to poor food choices and the excessive consumption of fat and sugary products in the daily intake. In this way, there is a need for alternative food

products, which the healthy nutritional intake is favored while these products satisfy sensorial requirements of consumers. One alternative is the development of innovative food products based on the mixture of products from vegetal and animal origin.

In this regard, the milk is one of the main sources of macronutrients, such as protein and fat and micronutrients such as calcium and vitamins A, B and D (Singh and Sachan, 2011). Currently, there is a wide variety in the market of dairy products that offer to consumers interesting options for satisfying the daily nutritional requirements found in the milk. One of the dairy products highly popular is the “koumiss” or “kymys”. This is a fermented dairy product originally from the Caucasian area in Europa. Similar products have been developed in Central Asia (Mongolia and China), where it is also known and “Chigee” and “Airag”. Koumiss is characterized by being produced from mare’s milk, which contains less casein and less fat content than cow milk. From the health point of view, this product as other originated from fermented have been associated to beneficial effect by means of microorganism-probiotic interaction, by microorganism

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metabolic production and their effect in protein digestion (Marsh *et al.*, 2014).

The traditional elaboration method of koumiss includes a fermentation process in bags made from the stomach of animals, in which the milk acidification takes place. The fermentation might be natural or an induced process (Mayo, 2015).

However, in Colombia koumiss is prepared from cow milk that is submitted to a lactic fermentation process. According to the Colombian regulation, this product is obtained by milk fermentation produced by *Lactococcus lactis* or *L. cremoris* (Colombia, 1986), being this a highly consumed dairy product.

Additionally, the beet is characterized by being a vegetable product rich in fibers and sugar and it is cultivated in several areas of the world. Additionally, the phenolic compounds of this vegetable present bioactive properties (Straus *et al.*, 2012).

On the other hand, the oat is a cereal of high nutritional value, contributing with vitamins, minerals and high fiber content (9-11%), which are essential for the human body (Borges *et al.*, 2006). Recently, the oat has received increasing attention from doctors, consumers and nutritionists due to the amount and quality of dietary fiber that oat possesses. The oat is considered as a functional food since its consumption includes the reduction of blood cholesterol, which contributes to preventing heart diseases (Gutkoski *et al.*, 2007).

This study aimed to develop an alternative dairy product, koumiss, by the incorporation of oat and beet and to characterize the sensorial and nutritional properties of the developed product.

MATERIALS AND METHODS

Raw materials: Pasteurized milk and starter microorganisms were used as raw materials for koumiss elaboration. Lactic acid bacteria have an important role in the food industry due to their contribution to the taste, flavor, texture, therapeutic properties and nutritional value. In this regard, the starter microorganism was used according to Colombian regulation (Colombia, 1986). Moreover, beet extract and oat (strawberry flavored from a commercial brand) were used for incorporation in the developed koumiss.

Product elaboration: Sugar (90 g) was added to each liter of pasteurized milk together with powder milk (15 g). Following this, the mixture was submitted to thermal treatment (85°C/15 min). Then, the temperature of the treated milk was diminished to 30°C, in order to be ready for the starter microorganism addition.

Finally, the mixture was homogenized during 3 min and placed in previously sterilized glass containers. The mixture was incubated at 22°C during 24 h.

Additionally, the beet extract was obtained manually for the elaboration of the final product and incorporated together with the oat in the prepared koumiss. Oat and beet were incorporated in the koumiss

Table 1: Formulation of koumiss development

Ingredient	Concentration (%)			
	F0	F1	F2	F3
Beet extract	0	25	25	15
Oat	0	8	15	8
Codification	F0	F1	F2	F3

in different proportion according to three main formulations (Table 1).

Sensorial analysis: The sensorial analysis was done randomly using a panel constituted by 30 untrained consumers, who tasted the developed product. Frequency of koumiss consumption, as well as demographic information of the untrained consumers, were obtained during the analysis.

The sensorial analysis was done using a 5 point hedonic scale, as follows:

- Dislike very much
- Dislike moderately
- Not sure
- Like moderately
- Like very much

The sensorial attributes of color, flavor, taste and texture of the developed products were evaluated. Moreover, the intention of consumption was studied using a 5 point scale, as follows:

- Certainly I would not consume it
- Probably I would not consume it
- I am not sure whether I would consume it
- Probably I would consume it
- Certainly I would consume it

Determination of the nutritional intake: The nutritional intake analysis was done according to the developed formulations and considering the information of the Colombian Ministry of Social Protection (Colombia, 2011).

Statistical analysis: The obtained data were analyzed through ANOVA and difference among treatments was determined by means of the Tuckey test at 5% probability. Data were analyzed used the statistical software SAS® v.7.

RESULTS AND DISCUSSION

Demographic characterization of untrained consumers showed that 53% of participants ranged between 15 to 20 years old, followed by 27% at ages between 21 to 30 and the rest of the participants were equally distributed in following ages. However, none of the participants were older than 60 year (Fig. 1).

Moreover, results from the frequency of consumption showed that 43% of the consumer participants in the sensorial analysis consume regular koumiss weekly, followed by 37% who consume this product daily. Moreover, a small percentage of

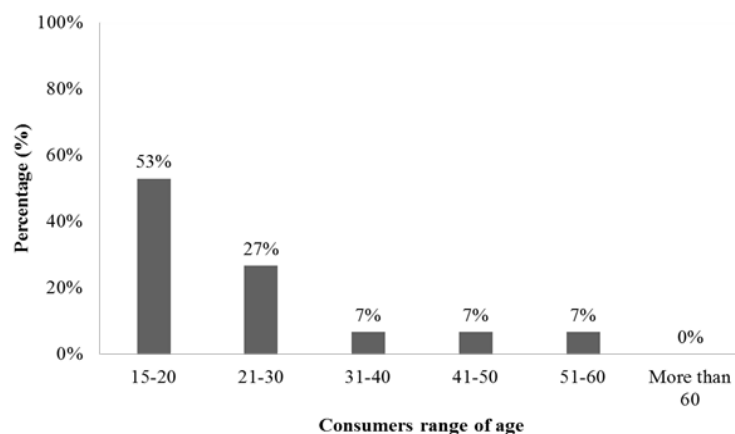


Fig. 1: Consumer range of age

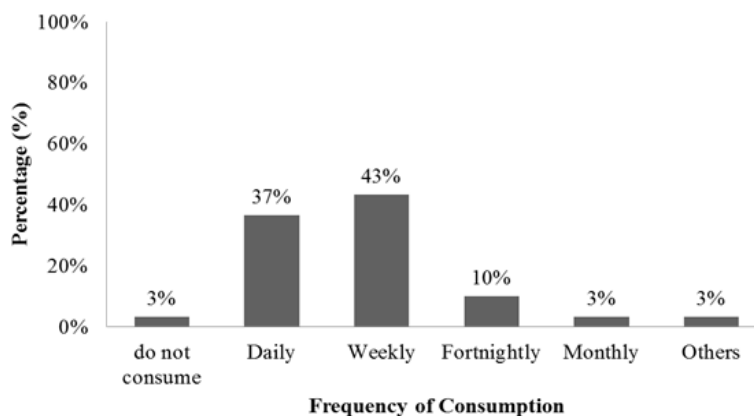


Fig. 2: Frequency of koumiss consumption

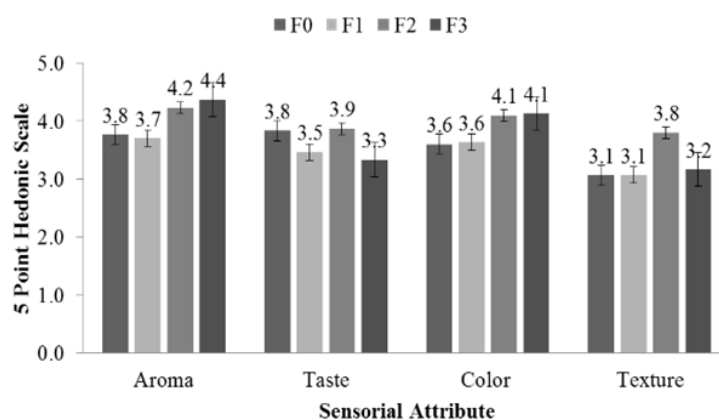


Fig. 3: Sensorial attributes of koumiss incorporated with beet and oat

participants were not consuming koumiss regularly (Fig. 2). In this regard, population in the rural and urban areas of Colombia, especially in the south west, is characterized by the high consumption of koumiss. This is usually a home-made dairy product which is obtained from the lactic acid fermentation in the milk disposed at room temperature (Chaves-López *et al.*, 2011). However, in northern regions of Colombia, such as the

Colombian Caribbean region, its consumption is growing due to the industrialization of this product.

Moreover, results from the sensorial analysis showed that formulation F2 and F3 presented the highest acceptance score for aroma and color; however, formulation F3 presented the lowest score for taste, not differing significantly from F1, while its texture was statistically similar to formulation F0 and F1 (Fig. 3).



Fig. 4: Physical appearance of developed koumiss

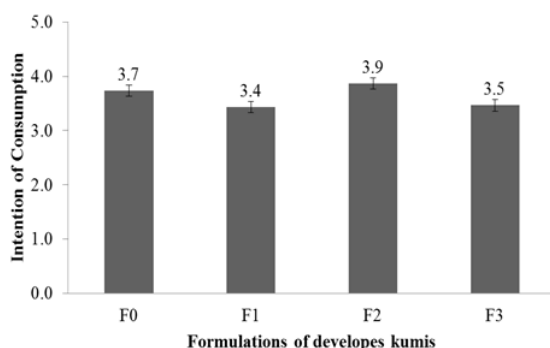


Fig. 5: Intention of consumption of developed koumiss

On the other hand, formulation F2 presented the highest value for taste. Although, the attributes of taste and texture presented the lowest acceptance scores of all tested attributes. This result might be related to the intense pink color of the product caused by the addition of the beet extract, which attracted the attention of potential consumers (Fig. 4). On the other hand, the texture of the developed product was influenced by the addition of oat, limiting the acceptance of this product.

Moreover, the intention of consumption showed that all prepared formulations had scores between (3) “I am not sure whether I would consume it”; (4) “probably I would consume it”, even for the control formulation (F0). This result was probably influenced by those participants who indicated that they do not consume the commercial koumiss found on the market. On the other hand, the intention of consumption of formulation F2 is in agreement with the sensorial scores obtained for it (Fig. 5).

Therefore, the developed product was an innovative alternative considering the acceptance and intention of consumption of the traditional product in the market.

Determination of the nutritional intake: The incorporation of dairy food products with food from vegetal source is growing since its effect in the nutritional value as well as its functionality due to the contribution to consumers’ health (Tomic *et al.*, 2017). The nutritional intake information was determined for the three developed formulations (Table 2).

According to the calculation of nutritional values, the protein content of developed koumiss is considerably increased after the incorporation of oat

Table 2: Nutritional intake of developed koumiss

Nutrient*	Formulation			
	F0	F1	F2	F3
Protein (g)	3.9	7.3	9.8	7.6
Lipid (g)	3.4	4.5	5.1	5.0
Carbohydrate (g)	18.2	32.3	39.7	33.6
Niacin (mg)	0.5	0.8	0.8	0.8
Riboflavin (mg)	0.1	0.2	0.2	0.2
Thiamin (mg)	0.1	0.2	0.3	0.2
Vitamin A (UI)	84.3	85.3	76.5	97.5
Fiber (g)	0.0	3.0	4.6	2.5
Folic acid (µg)	0.0	63.5	71.3	41.7
Iron (mg)	0.2	1.3	2.0	1.2
Zinc (mg)	0.4	1.2	1.7	1.2
Caloric intake (kcal)	92.5	168.4	209.4	175.0

*: Values calculated per 200 mL of the developed product

and beet, with formulation F2 presenting the highest value for this. A similar pattern was observed for carbohydrate and fiber content. Additionally, regarding micronutrients results showed that the incorporation of oat and beet contributes markedly with the folic acid, iron, zinc and with a lesser extend to vitamins.

Also, formulation F2 presented increased content of fiber. In this regard, Sah *et al.* (2016) have indicated that the incorporation of fiber in food products as the result of the perceived improvement of gut health conditions. In this regard, similar dairy products, such as yogurt, have been incorporated with natural fiber and have shown an increased acceptability (Karnopp *et al.*, 2017).

Moreover, all tested formulations presented an increased value for caloric intake, with formulation F2 being the highest energetic value. This is probably due to the high content of both vegetables incorporated in the developed koumiss.

CONCLUSION

The consumption of vegetables is lower than the recommended daily intake. One of the reasons is the high consumption of unhealthy products. In this study, an innovative food was developed to offer alternative products to consumers. In this regard, the developed koumiss incorporated with beet and oat, according to different formulations, presented a positive sensorial acceptance, as well as a positive intention of consumption.

CONFLICT OF INTEREST

Authors disclose that there is no conflict of interest.

REFERENCES

- Borges, J.T.D.S., M.R. Pirozi, S.M.D. Lucia, P.C. Pereira, A.R.F.E. Moraes and V.C. Castro, 2006. Utilização de farinha mista de aveia e trigo na elaboração de bolos. Dig. Library J., 24(1): 145-162.

- Bvenura, C. and D. Sivakumar, 2017. The role of wild fruits and vegetables in delivering a balanced and healthy diet. *Food Res. Int.*, 99: 15-30.
- Chaves-López, C., A. Serio, M. Martuscelli, A. Paparella, E. Osorio-Cadavid and G. Suzzi, 2011. Microbiological characteristics of kumis, a traditional fermented Colombian milk, with particular emphasis on enterococci population. *Food Microbiol.*, 28(5): 1041-1047.
- Colombia, 1986. Colombian Resolution 2310: Processing, Composition, Requirements, Transportation and Marketing of Dairy Derivatives. Ministry of Health, Bogotá, Colombia, pp: 41.
- Colombia, 2011. Colombian Resolution 333: Technical Regulation on the Labeling Requirements or Nutrition Labeling of Foods Packaged for Human Consumption. Ministry of Social Protection, Bogotá, Colombia, pp: 56.
- Gutkoski, L.C., J.M.D.A. Bonamigo, D.M.D.F. Teixeira and I. Pedó, 2007. Development of oat based cereal bars with high dietary fiber content. *Ciênc. Tecnol. Aliment.*, 27(2): 335-363.
- Karnopp, A.R., K.G. Oliveira, E.F. de Andrade, B.M. Postinger and D. Granato, 2017. Optimization of an organic yogurt based on sensorial, nutritional and functional perspectives. *Food Chem.*, 233: 401-411.
- Marsh, A.J., C. Hill, R.P. Ross and P.D. Cotter, 2014. Fermented beverages with health-promoting potential: Past and future perspectives. *Trends Food Sci. Technol.*, 38(2): 113-124.
- Mayo, B.A.L., 2015. Health Benefits of Fermented Dairy Products. In: Tamang, J.P. (Ed.), *Health Benefits of Fermented Foods and Beverages*. CRC Press, Boca Raton, pp: 232-260.
- Sah, B.N.P., T. Vasiljevic, S. McKechnie and O.N. Donkor, 2016. Physicochemical, textural and rheological properties of probiotic yogurt fortified with fibre-rich pineapple peel powder during refrigerated storage. *LWT-Food Sci. Technol.*, 65: 978-986.
- Singh, V.P. and N. Sachan, 2011. Nutraceutical properties of milk and milk products: A review. *Am. J. Food Technol.*, 6(10): 864-869.
- Straus, S., F. Bavec, M. Turinek, A. Slatnar, C. Rozman and M. Bavec, 2012. Nutritional value and economic feasibility of red beetroot (*Beta vulgaris* L. ssp. *vulgaris* Rote Kugel) from different production systems. *Afr. J. Agric. Res.*, 7(42): 5653-5660.
- Tomic, N., B. Dojnov, J. Miocinovic, I. Tomasevic, N. Smigic, I. Djekic and Z. Vujcic, 2017. Enrichment of yoghurt with insoluble dietary fiber from triticale-A sensory perspective. *LWT*, 80: 59-66.
- Wagner, M.G., Y. Rhee, K. Honrath, E.H. Blodgett Salafia and D. Terbizan, 2016. Nutrition education effective in increasing fruit and vegetable consumption among overweight and obese adults. *Appetite*, 100: 94-101.