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Effect of Blending Ratio of Mango Juice on Physicochemical and Sensory Acceptability of Soya Yoghurt, Southern Ethiopia

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ABSTRACT

This study was conducted on effect of blending ratio of mango juice on physicochemical and sensory acceptability of soya yoghurt. To evaluate physicochemical (PH, TSS and titratable acid) and sensory acceptability (color, taste, flavor, mouth feel and overall acceptability), four formulations of soya yoghurt samples were prepared from blending ratio of 100:0% (S_1), 90:10% (S_2), 80:20% (S_3), 70:30% (S_4) soya yoghurt and mango juice, respectively. Designs of the study were Completely Randomized for physicochemical properties and randomized complete block design for sensory acceptability with four treatments and three replications. Physicochemical properties (PH and TSS) of soya yoghurt samples had shown significant difference ($p < 0.05$) in mean scores, but titratable acid of soya yoghurt samples had not shown significant difference ($p < 0.05$) in mean scores when the amount of mango juice were increased in blending ratio. Sensory acceptability of soya yoghurt samples were increased as increase the amount of mango juice in blending ratio except color when panelists were evaluated. Soya yoghurt sample four (S_4) had highest mean scores of sensory acceptability (flavor = 4.65, taste = 4.53, mouth feel = 4.37 and overall acceptability = 4.93) as compared to other soya yoghurt samples. Control (S_1) soya yoghurt sample had highest mean score (4.67) of color than other soya yoghurt samples. Based on result of this study, soya yoghurt sample four (S_4 = 70% soya yoghurt: 30% mango juice) was recommended to increase sensory acceptability of soya yoghurt that is important for milk intolerance children. Further study will be needed on nutritional composition of soya yoghurt samples blended with mango juice.

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About the Author

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Introduction

Soya bean (*Glycine max*) is the most utilized legume as well as the most well researched and health-promoting food material in world today [1,2]. Soymilk is made by soaking soya-beans, grinding them with water by automatic soymilk maker; the fluid which resulted after filtering is called soya milk. Soya milk is affine, off-white or creamy emulsion, which resembles cow milk in both appearance and consistency.

The protein content in soymilk is 2.88 g/100 g, which is comparable to that in bovine milk (3.15 g/100 g). Soymilk has a well-balanced amino acid composition with high true ileal digestibility of 92.3%, producing a digestible indispensable amino acid score (DIAAS) of 117% that can be classified as an "excellent/high" quality protein source (DIAAS $\geq$ 100%). Natural soymilk normally supplies

18.5 mg of calcium, 0.5 mg of iron, 60.3 mg of phosphorus, 206 mg of potassium, 2.5 mg of sodium, 0.3 mg of zinc, and 22 mg of magnesium per 100 g. Soymilk provides more of the daily amounts of micronutrients of iron, potassium, and magnesium and less sodium than dairy milk, which contains 0.05 mg of iron, 151 mg of potassium, 13 mg of magnesium, and 49 mg of sodium per 100 g [3-6].

Soya milk has low cholesterol and lactose levels, ability to reduce bone loss and menopausal symptoms, prevention and reduction of heart disease and certain cancers [7]. In addition, some papers indicated that soy foods may decrease the risk of coronary heart disease have anti-cancer and anti-inflammation properties [8-9]. Soya foods, especially soya yoghurt are considered a good substitution for dairy products for individual who have milk intolerance. Milk intolerance including lactose intolerance is prevalent in the world, especially in children because of absence of lactase enzyme to digest lactose which is found in dairy milk.

Soya-yoghurt is a healthy protein source for those milk intolerant individuals. In addition, cow's milk contains saturated fats that might increase the risk of cardiovascular disease. Soya yoghurt, which contains much lower amounts of saturated fat than cow's milk, could be a good choice for individuals who are concerned about heart disease. Although soya yoghurt nutritious and their consumption have many health benefits, it has some limitation

such as beany flavor. However, Soymilk has poor consumer acceptability, principally because of the “beany flavor” and flatulence inducing oligosaccharides such as starchyose and raffinose. In oxidation reactions, LOX isozymes require substrates containing polyunsaturated fatty acids. These polyunsaturated fatty acids contribute to beany or grassy flavor in soya beverage [10,11].

Fermentation of soy milk with starter culture for the production of yoghurt- like product improves its sensory attributes, but not more. Lactic acid fermentation has been reported as a means to reduce “beany” flavor. The commonly used starter culture for conventional yoghurt produces adequate amounts of acid in soy yoghurt; it has been reported that its major disadvantage, however, is the non-production of the buttermilk-like aroma and flavor that is associated with cow milk-based yoghurt [12,13].

This can also be done by blending the beany flavor with sweetening and flavoring fruit. Presently, some fruit juice blended soy beverages are available in the market. Mango is known as the king of the fruits due to its excellent flavor, delicious taste and high nutritive values [14,15]. That makes the crop valued for both food and nutritional security especially for developing countries like Ethiopia. It has a delicious taste (delightfully blended sweetness and acidity) and aroma, and high nutritional value. Blending of soya yoghurt with flavored mango fruit juice to reduce beany flavor work has not yet been done in south region of Ethiopia. Therefore, this study was conducted to evaluate physicochemical and the sensory acceptability of soya yoghurt blending with pineapple juice.

Materials and Methods

Sources of Materials

To conduct this experiment, a range of materials were used. The materials were soya bean, dairy yoghurt, mango fruit, water, automatic soya milk making machine, table spoon, beaker, Juice extraction machine, PH meter, refrigerator and refractometer. Soya bean seed was obtained from South Agricultural Research Institute, Arba Minch Agricultural Research Center. Then the soya bean seed was stored in food chemistry laboratory at room temperature until used. Mango fruit was bought from Arba Minch local market, and dairy yoghurt which was used as starter culture was bought from Arba Minch supermarket and stored refrigerated temperature in food microbiology laboratory till it was used. All necessary materials such as Water, automatic soya milk making machine, table spoon, beaker, Juice extraction machine, refrigerator, PH meter and refractometer were obtained from Arba Minch University Abaya Campus.

Experimental Design

Complete Randomized Design (CRD) was used to evaluate the effect of mango juice on the physicochemical properties and randomized complete block design (RCBD) was used to analyze sensorial acceptability of soya yoghurt samples with three replications.

Preparation of Soya Milk

The soya bean was cleaned to remove stones, impurity and other contaminants. Then, the healthy and unbroken soya bean seeds were soaked in water for 12 hours and then the beans were rinsed with tap water. According to the user’s manual of automatic soya milk maker, 2 liters of water was added in the jar and soaked soybean was added in the hopper until it fills. Then, after the hopper closed, the socket was plugged and the machine started to extract soya milk. Finally, after 30 minutes soya milk was collected from the jar.

Preparation of Soya Yoghurt

10 mill liters (ml) of starter culture (dairy yoghurt) were added on 2 liters soya milk and well mixed, and then it were incubated at 37°C for 12 hours. Then, soya yoghurt was produced.

Preparation of Mango Juice

The mango fruits were sorted and washed in tap water, peeled manually with a sharp knife and the cut into slice. The seed of mango fruit were removed manually and the pulp was cut into thin slices. The mango slices was blended by using juice blender, and then filtered by using cheese and mango juice was produced.

Formulation of Blending Ratio

The soya yoghurt was blended with mango juice based on blending ratio. 100% (S_1) of soya yoghurt used as a control treatment, 90:10% (S_2), 80:20% (S_3) and 70:30% (S_4) of soya yoghurt and mango juice was respectively. The mixture was stirred and filled into cleaned bottles and stored until it was evaluated sensorial acceptability and physicochemical properties.

Sensorial Acceptability of Soya Yoghurt Samples

The soya yoghurt samples blended with mango juice was evaluated for their sensorial acceptability such as taste, color, flavor, mouth feel, and overall acceptability by using 20 untrained panelists who were familiar with yoghurt. A five point hedonic scale which was rated as: 1-dislike very much, 2-dislike moderately, 3-neither dislike nor like, 4-like moderately, 5-like very much with three replication. The samples were code and clean water was presented for each panelist for palate cleaning.

Physicochemical Properties of Soya Yoghurt

Titrateable acidity (TA) soya yoghurt sample was measured by titration of 10 mL soya yoghurt with 0.1 N NaOH to pH 8.1 (mod. S compact titrator, Crison Instruments, Barcelona, Spain) and expressed as percent (%) of lactic acid. PH value of soya yoghurt samples were measured directly by using PH meter that was standardized with PH 4, 7 and 9 buffer solutions. Total soluble solid (TSS) of soya yoghurt samples were determined on some droplet of sample by digital refractometer (Palette PR-32, Atago Co., Ltd), and expressed in degree brix.

Data Analysis

Data analysis was carried out using one way analysis of variance (ANOVA). The least significance difference (LSD) was used to determine significances among means, when ANOVA is significant at $p < 0.05$. The results were expressed as mean separation.

Results and Discussions

Physicochemical Properties of Soya Yoghurt

The result on table 1 had shown that the blending ratio of mango juice on physicochemical properties (PH, titrateable acidity and total solid soluble) of soya yoghurt samples. PH of soya yoghurt samples had shown significant difference ($p < 0.05$) in mean scores. PH value of control sample of soya yoghurt had highest mean score ($S_1 = 4.70$) than other samples mean scores of PH value ($S_2 = 4.58$, $S_3 = 4.50$ and $S_4 = 4.41$) of soya yoghurt this is due to absence of mango juice in blending ratio while sample four (S_4) of soya yoghurt had least mean score of PH value (4.41) than others samples mean scores of PH value ($S_1 = 4.70$, $S_2 = 4.58$ and $S_3 = 4.50$) because of high amount of mango juice in blending ratio which converted to organic acid in soya yogurt. The ranges for PH value of soya yoghurt samples were 4.41-4.70, however these values were slightly related to Mital and Steinkraus (1974) reported the PH ranges (4.26-4.7) of soya yoghurt reported by [16]. The decrease mean score in PH values of yoghurt samples

mango juice blended with mango juice may attributed as a result of less PH value of mango juice.

Table 1: Mean Separation of Physicochemical Properties of Soya Yoghurt

Samples	Physicochemical properties of soya yoghurt		
	PH	Total Solid Soluble	Titrateable acidity
S ₁ =100% of soya yoghurt	4.70 ^a	4.50 ^d	0.25 ^a
S ₂ =90% soyayoghurt:10% mango juice	4.58 ^b	6.06 ^c	0.23 ^a
S ₃ =80% soya yoghurt:20% mango juice	4.50 ^c	9.58 ^b	0.21 ^a
S ₄ =70% soya yoghurt:30% mango juice	4.41 ^d	11.90 ^a	0.19 ^a
LSD(p< 0.05)	0.027	0.950	0.093

Total soluble solid (TSS) of soya yoghurt sample had shown significant difference in mean scores. Control sample (S₁) of soya yoghurt had least mean score (S₁ = 4.50) of TSS among other samples mean scores (S₂=6.06, S₃ = 9.58 and S₄=11.90) of soya yoghurt this was due to absence of mango juice in soya yoghurt during blending time while sample four of soya yoghurt had highest mean score (S₄ = 11.90) of TSS content among other soya yoghurt samples mean scores (S₁=4.50, S₂=6.06 and S₃=9.58) this was due to highest amount of mango juice added to soya yoghurt that might have increase total solid soluble in soya yoghurt sample. The high sugar content of fruit added to soya yoghurts might have contributed to the higher total soluble solid recorded.

Titrateable acidity (TA) of soya yoghurt samples had not shown significant difference (p<0.05) in mean scores. The ranges for titrateable acid content of soya yoghurt sample were 0.19-0.25. Soya yoghurt sample four had least mean score (S₄=0.19) of titrateable acidity among other soya yoghurt samples mean scores (S₁ = 0.25, S₂ = 0.23 and S₃ = 0.21) while control sample had highest mean score (S₁ = 0.25) of titrateable acid content among others soya yoghurt samples. Titrateable acid content of soya yoghurt samples were decreased as increase the amount of mango juice in blending ratio this was due to the addition of mango juice in blending ratio as a result titrateable acid of soya yoghurt samples were decreased.

Sensory Acceptability of Soya Yoghurt

The result on table 2 showed that, the soya yoghurt samples had shown significant difference in mean scores of color. The ranges for color of soya yoghurt samples were (1.33-4.67). Control sample of soya yoghurt had highest mean score (S₁ = 4.67), this was because all panelists were familiar with white color of soya yoghurt sample which was similar color with dairy yoghurt while sample four (S₄) of soya yoghurt had least mean score (3.27) of color, because of highest amount of mango juice addition than other samples during blending that could change the normal color of soya yoghurt. Color is one important quality parameter among sensory properties of food and food products in order to attract consumers' interest. Color is also added to foods to stimulate the appetite as well as stimulating physical and physiological reactions [17-19].

Table 2: Mean Separation of Sensory Acceptability of Soya Yoghurt

Samples	Sensory Acceptability				
	Color	Flavor	Taste	Mouth feel	Over all Acceptability
S ₁ = 100% of soya yoghurt	4.67 ^a	1.66 ^b	2.34 ^b	1.35 ^b	1.94 ^d
S ₂ = 90% soya yoghurt :10% mango juice	3.32 ^b	3.67 ^a	3.32 ^{ab}	3.18 ^a	3.06 ^c
S ₃ = 80% soya yoghurt : 20% mango juice	2.31 ^c	4.33 ^a	4.01 ^a	4.24 ^a	3.87 ^b
S ₄ =70% soya yoghurt: 30% mango juice	1.33 ^d	4.65 ^a	4.53 ^a	4.37 ^a	4.93 ^a
LSD(p<0.05)	0.957	1.273	1.197	1.485	0.957

The flavor of soya yoghurt samples had not shown significant difference in mean scores except mean score of control sample. Control sample of soya yoghurt had least mean score (S₁ = 1.66) of flavor because bean flavor that was come from soya bean while sample four of soya yoghurt had highest mean score (S₄ = 4.65) of flavor, this was because addition of mango juice in blending ratio that might increase the flavor of soya yoghurt samples.

The taste of soya yoghurt samples had not shown significant difference in mean scores of taste except control sample of soya yoghurt, and also control sample (S₁) and sample two (S₂) had not shown significant difference in mean score of taste. Control sample of soya yoghurt had least mean score (S₁ = 2.34) of taste while sample four of soya yoghurt had highest mean score (S₄ = 4.53) of taste.

The mouth feel of soya yoghurt samples had not shown significant difference in mean scores except mean score of control sample

(S₁). Control sample (S₁) of soya yoghurt had least mean score (1.34) of mouth feel while sample four (S₄) of soya yoghurt had highest mean score (4.37) of mouth feel.

The overall acceptability of soya yoghurt samples had shown significant difference in mean scores. Control sample (S₁) of soya yoghurt had least mean score (1.94) of overall acceptability while sample four (S₄) of soya yoghurt had high mean score (4.93) of overall acceptability because high amount of mango juice in blending ratio than other soya yoghurt samples.

In general, sensory acceptability of soya yoghurt samples were increased as increase the amount of mango juice in blending ratio except color, this was indicate that mango juice had excellent flavor and delicious taste to enhance sensory acceptability of soya yoghurt.

Conclusions and Recommendations

Soya foods, especially soya yoghurt are considered a good substitution for dairy products for individual who have milk intolerance. Milk intolerance including lactose intolerance is prevalent in the world, especially in children.

Based on result of this study, physicochemical properties (PH and titratable acidity) of soya yoghurt samples were decreased as increase the amount of mango juice in blending ratio while total soluble solid (TSS) of soya yoghurt samples were increased as increase the amount of mango juice in blending.

The sensory properties of soya yoghurt samples were increased as increase the amount of mango juice in blending ratio whereas the colors of soya yoghurt samples were decreased. Soya yoghurt sample four (S₄) which was blended (70% soya yoghurt: 30% mango juice) had highest mean scores of sensory acceptability (flavor, taste, mouth feel and overall acceptability) as compared to soya yoghurt samples (S₁, S₂ and S₃). Control (S₁) soya yoghurt sample (100% soya yoghurt) had highest mean score (4.67) of color than other soya yoghurt samples (S₂=90 soya yoghurt: 10% mango juice, S₃=80% soya yoghurt: 20% mango juice and S₄=70% soya yoghurt: 30% mango juice).

In general, study had shown that 70% soya yoghurt: 30% mango juice blend was the most acceptable by panelists. Mango juice can be used as fortificant to increase sensory acceptability of soya yoghurt that was important for milk intolerance children. Further study will be needed on nutritional composition of soya yoghurt samples blended with mango juice.

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Declaration of Competing Interest

The author declares no competing of interest on this research work that would bias the collection, analysis and publishing of this paper.

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