



Nutritional Composition of Milk Stick Product with Moringa Extract Nano Emulsion as Fortification

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Abstract. Moringa extract (*Moringa oleifera* L) has many properties including as an antioxidant, antimicrobial and various other health benefits. Moringa extract made onto form of nanoemulsion, became an agent of bioactive compounds that have higher absorption towards the target cell. The purpose of this study was to determine the nutritional composition of milk stick snack products made using cow's milk curd with moringa extract nanoemulsion fortification at a concentration of 0.5% as a food additive. This study was conducted with the stages of making milk sticks with moringa extract nanoemulsion fortification and proximate testing which includes protein, fat, water content, ash and carbohydrate. The data were analysed using general linear model (GLM), if there was a significant effect, followed by the Tukey's test. The results obtained proximate results with protein content of $10.033 \pm 0.11\%$, fat content of $32.35\% \pm 0.21$, moisture content of $4.83\% \pm 0.15$, ash content of $3.02\% \pm 0.04$ and carbohydrate content $49.76\% \pm 0.29$. This study can be concluded that the fortification of moringa extract nanoemulsion affects the proximate value of milk sticks.

Keywords: milk stick, nano emulsion, moringa extract, proximate.

1 Introduction

Milk is a source of protein. In addition to protein, milk has some essential content that is needed by the body. The chemical composition includes protein and fat in the milk of 3.43% and 4.28% [1]. Milk has protein and fat content in of 3.5–3.8% and 6.98–7.35% [2]. Milk also contains inorganic minerals. Inorganic mineral occurs in milk as inorganic ion and salt [3]. The high content of protein and fat encourages to make product diversification of milk dairy products. A diversification of dairy products to increase the product value rather than pure fresh milk (raw fresh milk) [4].

The potential for milk production in Indonesia is quite high, one of the largest milk producers in East Java is KUD Sumber Makmur Ngantang engaged in the dairy sector with a daily milk production of 76,000 liters/day. So far, it has only been processed simply. The water component is high enough to make milk susceptible to

damage caused by microorganisms. As a result of these microorganisms, fresh milk has a short shelf life. Thus, it is necessary to process milk to increase the shelf life of milk. One of the dairy products that have a relatively long shelf life is milk sticks. This potential can be optimized through innovative post-harvest milk processing technology into processed products.

Milk stick is a diversified dairy snack made from milk curd, wheat flour, tapioca flour, eggs, salt, sugar and baking powder. The use of curd, which is the part of the milk clot that contains a lot of protein and fat, will increase the nutritional and sensory value of milk snacks because curd is rich in milk protein, namely casein [5]. Four casein protein families (κ -, β -, α S1-, and α S2-caseins) have evolved in different mammalian species to maintain specialized roles in milk [6], and their primary function is the provision of nutrients and minerals, especially calcium, to offspring while maintaining fluidity in mammary glands. Caseins are associated with each other and with calcium phosphate in the form of colloidal nanostructures called micelles. Together with the fat globules, whey protein, and minerals in milk, these micelles play important roles in preventing the precipitation of casein proteins and in stabilizing milk as an emulsion [7].

Nowadays, consumers are getting more conscious about their eating habits and considering nutritionally enriched food either by plant or animal origin. Everyone needs specific amounts of certain nutrients to maintain and regulate the body's functions. Plants are great sources of micronutrients and health-beneficial bioactive compounds. Among plants *Moringa oleifera* is well-known as a miracle tree due to its richness in bioactive compounds. *Moringa oleifera* extract, which is rich in bioactive components including flavonoids, quercetin, β -sitosterol, and zeaxanthin was then made in the form of a nanoemulsion which will be used as a fortificant in the milk stick products made [8].

Nanoemulsion of moringa leaf extract has better solubility than moringa leaf extract. Nanoemulsion also has higher bioavailability (61.33%) compared to moringa extract emulsion (15.83%). By making emulsion using tween 80, moringa extract nanoemulsion can be used as food fortificant into milk stick product because it is stable to centrifugation and stable to heat treatment [9].

Based on the description above, milk stick products made with moringa nanoemulsion were tested for nutritional content with proximate tests including carbohydrate content, protein content, fat content, moisture content and ash content. This product is expected to be an alternative snack that is nutritious and has functional value for health.

2 Materials and Methods

2.1 Materials

Milk stick products. Fresh Milk from KUD Ngantang, 1 tbsp cooking vinegar, 150 grams tapioca flour, 550 grams wheat flour, 15 grams salt, 100 grams margarine, 1 round egg, 2 grams baking powder, 50 grams cheddar cheese, seasoning (garlic, mushroom bouillon), palm oil.

Moringa Nanoemulsion. Red stalk Moringa oleifera powder from Bluto, Sumenep; food grade-ethanol 96%; emulplex and tween 80.

2.2 Methods

Preparation of Moringa Nanoemulsion. About 100 grams of moringa flour maserated with food grade-ethanol 96% (1:5) within 24 hours in room temperature. The extraction result was then filtered using Whattman filter paper then evaporated with rotary vacuum evaporator at temperature 60°C. The evaporated extract added with tween 80 (conc. 5%) and 0,5% emulplex, then homogenized with ultraturrax 220 V, 800 watts, at speed 25000 rpm, within 10 minutes. The result of nanoemulsion process were then checked for particle size using Particle Size Analyzer [10].

Preparation of Milk's Curd. Prepare 1 liter of fresh milk then pasteurized. The pasteurized milk was heated to 40°C, followed by coagulation at this temperature with 1 tablespoon of cook vinegar, till the attainment of a uniform curd. The curd was immediately drained through muslin cloth without pressing [11].

Preparation of Milk Stick Product. In order to making the milk stick dough needed to mix melted margarine, sugar, salt, mushroom buillon, baking powder, and eggs until homogeneous, stir evenly, or use a blender then add the milk's curd and stir again until evenly mixed. After everything is mixed well, add the mixture of wheat and tapioca then knead the dough until smooth. Extract moringa nanoemulsion adden into the dough with concentration 0,5%, rest it for about 10 minutes wrapped with plastic. The next step is shaping dough sheet then cut into an elongated flat form using pasta maker. Fried the elongated flat form dough in hot palm oil until golden brown and crisp [5].

2.3 Data analysis

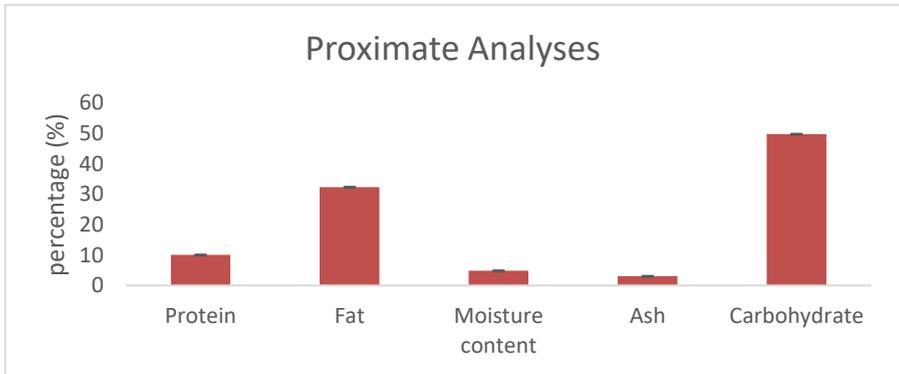
The proximate analysis was conducted in the Nutrition Laboratory of the Faculty of Agricultural Technology, Universitas Brawijaya. The data were analysed using general linear model (GLM), if there was a significant effect, followed by the Tukey's test.

3 Results and Discussion

The results of the proximate test on milk sticks can be seen in Table 1. The results obtained proximate results with protein content of $10.033 \pm 0.11\%$, fat content of $32.35\% \pm 0.21$, moisture content of $4.83\% \pm 0.15$, ash content of $3.02\% \pm 0.04$ and carbohydrate content $49.76\% \pm 0.29$.

Table 1. Proximate result of milks stick product.

Variables	Proximate
Carbohydrate	49.76% ± 0.29
Protein	10.033% ± 0.11
Fat	32.35% ± 0.21
Moisture Content	4.83% ± 0.15
Ash	3.02% ± 0.04

**Fig 1.** Proximate result of milks stick product

3.1 Carbohydrate Content

Based on Table 1, carbohydrate content is the largest composition of milk stick product (49.76% ± 0.29). This is because in the dough formation of milk stick formula the largest component used is flour. The flours used in making dough are wheat flour and tapioca flour. Wheat flour and tapioca flour are sources of carbohydrates especially starch. For normal tapioca starch, the amylose content generally ranges from 15.2% to 26.5% (20.7% on average) [12] who measured 4000 cassava genotypes, and flour starch of wheat usually consists of about 25% amylose and 75% amylopectin.

In food applications, starch and flour are multifunctional food ingredients and have been used as a texturizer, a binder, an emulsion stabilizer, a moisture retainer or a coating agent and are relatively affordable [13]. Tapioca starch in formula, which contributes as a good binder, by absorbing water and forming a thick gel with high viscosity, improving water/moisture retention and cooking yield. Wheat flour, on the other hand, contains a higher percentage of amylose (20% to 25%) and protein (8% to 15%), which provides products a better expansion quality in cooking [14].

This occurrence may be related to the moderate production of browning compounds formed in the Maillard reactions due to interactions between protein and carbohydrate at high temperatures when milk stick are fried [15]. Color influences the quality of food and its appeal to consumers especially in milk stick product. Carbohydrate content in

milk stick cause the formation of maillard reaction is primarily responsible for color development [16]. In addition, the fried process also develops flavor and aroma due to the browning effect of the maillard reaction on the food surface [17]. These also occurrences provided the most positive effects on the sensory attributes of the beef snacks obtained from wheat flour with 0.625% (w/w) [18].

3.2 Protein Content

The protein content of milk stick product is $10.033\% \pm 0.11$. The adding of milk curd will enhance the protein concentration in product. Curd is a white lump that mostly composed of milk casein that coagulates due to coagulant activity in the form of either acids or proteolytic enzymes. Casein is the main protein of milk. It accounts for up to 80% of the total protein available in the form of calcium caseinate which is a complex compound of calcium phosphate that exists in the form of colloidal complex particles called micelles [19].

Protein content of curd ranges from 12 - 21%. The addition of curd in snack formula will increase the protein content of the product so that resulting nutritional quality. This is in line with research on the effect of the addition of milk curd in the manufacture of snacks. The results showed that the higher the percentage of curd used is directly proportional to the protein content of the milk snacks produced [20].

The deep fat frying method which was applied in making milk stick can reduce the lysine content by about 17-25%, when the oil has been used for continuous frying for 48 hours. As a result of the interaction between lysine and carbonyl compounds involved in the Maillard reaction. However, there is no significant effect of frying on the amino acid content (histidine, threonine, valine, methionine, leucine, isoleucine, phenylalanine, arginine, aspartic acid, serine, glutamic acid, proline, glycine, alanine, cysteine and tyrosine) [21].

3.3 Fat Content

The fat content in milk stick product is $32.35\% \pm 0.21$. The source of fat in this product is because it contains egg yolk, milk curd and is processed with deep fat frying. Curd made from fresh raw from KUD Ngantang and by using raw milk from farmers, the milk curd produced is more abundant and sturdy, rich in protein and fat. The fat content of curd is 8.39%, the egg yolk contain 27% fat and margarine also fat source ingredient [22].

The high fat content in milk snacks when compared compared to flour-based snacks comes from the raw material (curd) which is rich in milk fat and oil absorption during frying. Oil absorption during frying also takes place. During frying, the oil will enter the air voids left by the evaporated water. Products containing curd will experience a fast frying process and be able to produce a product with an attractive golden yellow colour crispy texture, and good flavour quality with an oil absorption of about 8 - 25% [23].

3.4 Moisture Content

The moisture content of the product is $4.83\% \pm 0.15$. The moisture content in the product is quite low because the manufacturing process is carried out using the deep fat frying method. Curd added to the milk snack dough will reduce the use of flour-based ingredients that will gelatinize and form a gel matrix when exposed to heat above their gelatinization temperature and became evaporation path. Similar studies reported that the moisture retention of snack made from beef products was due to the ability of the protein matrix to retain water. The moisture content can be due to the different level of protein content and its ability to keep moisture in the snack matrix [24].

The moisture content of the product affects the crunchiness of the product. Mixing of the dough contented curd, amyloza and amylopectine will place the curd around the gel matrix that forms and will be the pathway for water evaporation. It would reduce the water content to a minimum during frying and crust formation. The formula of milk snack product can produce minimal water content with good crispness, because moisture content of the product affects the affecting the deterioration of the product that occurs during storage [25].

3.5 Ash Content

The Ash content of product is $3.02\% \pm 0.04$ Ash content is a mixture of inorganic or mineral components found in a food ingredient The high or low ash content of a material is partly due to the different mineral content at the source of raw materials. The addition of curd to milk sticks increases the mineral content of the resulting product because ash content is a measure of the total amount of minerals present within a food, The ash content of products containing coagulated milk such as curd is influenced by the cooking time and the coagulant used, resulting in an increased demineralisation process. Acid solution can hydrolyse the mineral content in food products so that it can affect ash content in food products. And also heating ini deep frying process will cause the products moisture content decrease to increase mineral concentration [26].

Nanoemulsions have proven quite useful in bioavailability, bioactivity, digestibility, stability, safety, quality, and sensory enhancements of food components and natural extracts, such as lycopene-solubilized and β -carotene-based nanoemulsions. Composed by multiple bioactive substance. Furthermore, it can improve the physicochemical characteristics of food, increasing its quality and shelf life [27]. This milk stick product is a snack product that has high nutritional value and can be a functional food snack that is beneficial for health.

4 Conclusion

The results obtained proximate results of mlik stick product with moringa extract nanoemulsion as fortification showed protein content of $10.033\% \pm 0.11$, fat content of $32.35\% \pm 0.21$, moisture content of $4.83\% \pm 0.15$, ash content of $3.02\% \pm 0.04$ and carbohydrate content $49.76\% \pm 0.29$.

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