Addition of *Moringa oleifera* Lam. Leaves Flour for Increasing the Nutritional Value of Modified Cassava Flour–Based Breakfast Cereal

Novian Wely Asmoro[1,*], *Agustina* Intan Niken Tari[1], *Retno* Widyastuti[1] and *Chandra* Kurnia Setiawan[2, 3]

[1]Department of Agricultural Product Technology, Faculty of Agriculture, Universitas Bangun Nusantara, Sukoharjo, Jl. Letjend Sujono Humardani No.1, Bendosari, Kabupaten Sukoharjo 57521, Central Java, Indonesia
[2]Department of Agrotechnology, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, Jl. Brawijaya, Kasihan, Bantul 55183, Special Region of Yogyakarta, Indonesia
[3]Department of Horticulture, Faculty of Agriculture, Kasetsart University at Kamphaeng Saen Campus, 1 M.6 Kamphaeng Saen District, Nakhon Pathom 73140, Thailand

Abstract. Many Indonesian children have a habit of not eating breakfast according to balanced nutritional needs. Breakfast provides a third of daily nutritional needs. This study aims to evaluate the potential and determine the formulation of breakfast cereals using Mocaf Cassava Flour (MOCAF) enriched with Moringa Leaves Flour (MLF) to add nutritional value to the product. The experimental design was Completely Randomized Design (CRD) with one treatment, addition of dry Moringa leaf flour as much as 0 % as a control, and 5 % w w^{-1}, 10 % w w^{-1}, and 15 % w w^{-1} as the treatment. The results showed that the addition of MLF in MOCAF flour had the potential to increase the nutritional value of breakfast cereal products. The addition of MLF with a percentage of 5 %, 10 %, and 15 % had a significant effect ($p < 0.05$) on water content, ash content, and fat content. The addition of MLF up to 15 % increases ash content by 2.79 % and fat content by 8.2 %.

Key words: *Cassia fistula*, drumstick tree, fungsional food, increase nutrition, kelor

1 Introduction

More than 50 % of Indonesian children have a habit of not eating breakfast according to balanced nutritional needs. Breakfast provides daily nutritional needs. It is increasing concentration when receiving lessons at school. The schools in Pacitan, East Java, Indonesia about 74 % had no breakfast habits which resulted in the emergence of malnutrition and obesity [1]. Lifestyle, business, and the not practical preparing breakfast are the causes of not eating breakfast. There needs an alternative practical breakfast [2]. Comercial breakfast foods must meet the nutrients needed by the body. Developing healthy

* Corresponding author: novianwelyasmoro@gmail.com

breakfast foods is done by making composite products by mixing various ingredients to produce the expected nutritional content. High–quality breakfast food made by mixing of ingredients.

Breakfast foods containing carbohydrates as the main energy source come from tubers, a source of protein obtained from mixing nuts, and a source of vitamins and fiber from fruit [3]. Foods that provide health benefits can reduce the risk of disease was called functional foods. Functional food components can naturally come directly from the foodstuff but can also be obtained from the fortification process by adding functional components from other foodstuffs [4]. One of the plants that can be used to increase the functional value of food is *Moringa oleifera* Lam. leaves. Previous studies mention that *M. oleifera* leaves have high protein, vitamin C, and calcium values of 23.78 %, 56 mg, and 3 467 mg 100 g^{-1} of dried leaves respectively. Other studies show moringa leaves have seven times the vitamin C content of oranges, four times the calcium content of milk, four times the vitamin A content of carrots, three times the potassium content of bananas, and two times the protein content of yogurt [5].

Breakfast cereal formulations can use a mixture of various ingredients, but basically must meet at least 300 Kcal nutritional needs of breakfast and meet the organoleptic aspects preferred by consumers, including texture/crispness, taste, and aroma. Research related to the addition of Moringa Leaves Flour (MLF) conducted by [6] showed that the acceptance of wet noodles by panelists on the addition of MLF to 2 % in terms of color, taste, and texture, although the aroma aspect was less favored. As well as increasing levels of wet noodle protein with the addition of 2 % MLF by 14.84 %.

This study aims to evaluate the potential and determine the formulation of breakfast cereals using Modified Cassava Flour (MOCAF) enriched with MLF to add nutritional value to the product.

2 Methods

Mocaf flour obtained from Wonogiri, Indonesia. Cereal was made from mocaf flour, wheat flour, and MLF. The process of making cereal begins with the preparation of MLF as a composite of cereal raw materials. Mix all raw materials into dough and form into sheets with a thickness of 1 mm to 2 mm, then cut into squares. Pieces of dough are steamed and then roasted using a temperature of 120 °C, subsequently tested the chemical and nutritional content of the cereal product.

Completely Randomized Design (CRD) was used in this study with treatment 0 % of MLF as a control (K), 5 % (K1), 10 % (K2), and 15 % (K3) (w w^{-1}). All treatment replicated four times. Each unit was tested with three samples.

3 Results and discussions

3.1 Cereal

Cereal products produced from variations in the addition of MLF can be seen in Figure 1. In Figure 1A, 1B, 1C, and 1D, respectively are cereal products with the addition of MLF as much as 0 %, 5 %, 10 %, and 15 %. The green color in the leaves of Moringa powder caused discoloration of cereals from yellowish–white to green. The higher concentration of moringa leaves, the greener cereal product.

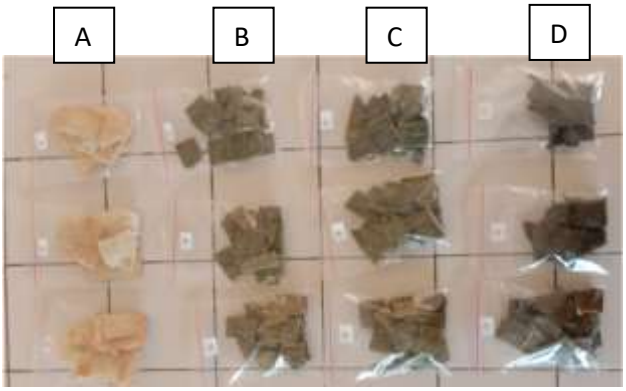

Fig. 1. Breakfast cereal products with addition of MLF (Product formula successively A, B, C and D with the addition of 0 %, 5 %, 10 % and 15 % MLF)

3.2 Water content

The result showed that water content was different among treatments ($p < 0.05$). Figure 2 showed that the addition of MLF value of water content decreased at 0 %, 5 %, 10 % and 15 % by 8.45 %, 7.56 %, 6.22 % and 5.85 % respectively. Water content, in general, is an important component in food because water can affect the appearance, texture, and taste of food [7]. Water content is influenced by the main ingredients of breakfast cereal products, i.e wheat flour, mocaf flour, and MLF. The addition of MLF caused the percentage of other ingredients (mocaf flour and flour) in cereal product formulations decrease. Meanwhile, mocaf flour is one of the ingredients that can bind water to the dough. It caused water content decreased in line with the addition of MLF.

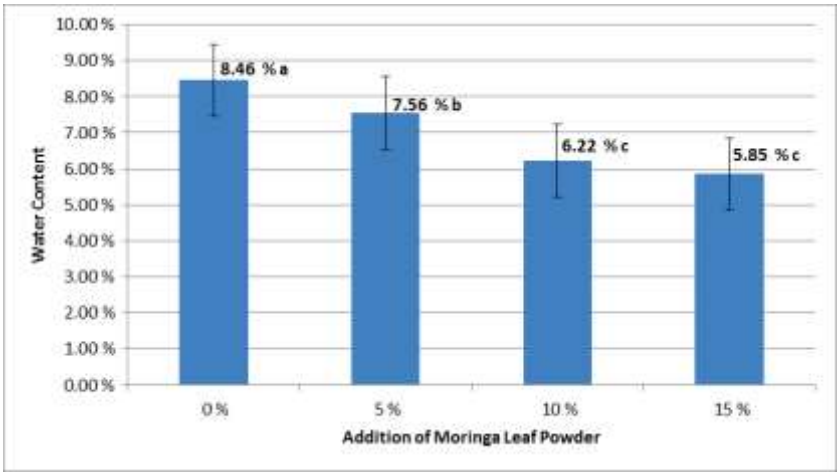

Fig. 2. Moisture content of cereal product with the addition of MLF

3.3 Ash content

Figure 3 showed that the addition of MLF successively increases the value of ash content, where the addition of MLF by 0 %, 5 %, 10 %, and 15 % increases the value of ash content

1.03 %, 1.80 %, 2.24 % and 2.79 % respectively. Statistical analysis of ash content showed that there were significant differences among breakfast cereal products ($p < 0.05$). Ash content generally indicated the mineral content of the product. The addition of MLF caused an increase in mineral content of breakfast cereal products. That was because the mineral content found in Moringa leaves [8]. Moringa leaves had calcium of 440 mg g^{-1} and potassium of 259 mg g^{-1} [9]. It also had magnesium, phosphorus, and sodium of 8.79 g kg^{-1}; 3.70 g kg^{-1} and 0.6 g kg^{-1}, respectively [10].

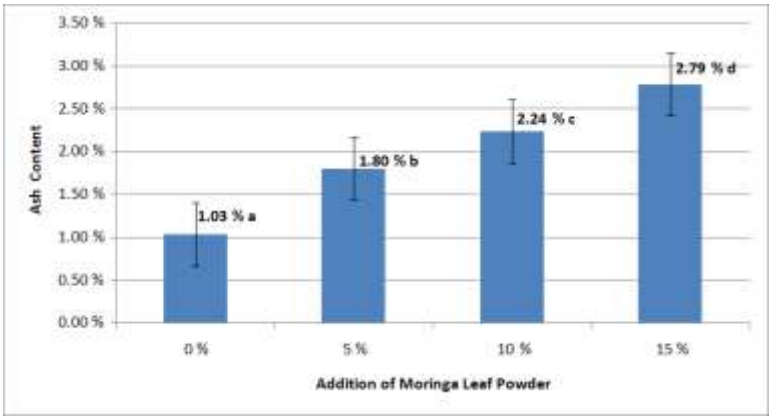

Fig. 3. Ash content of breakfast cereals with addition of MLF

3.4 Fat content

The addition of MLF had a positive influence on increasing fat content of breakfast cereal products, from 6.4 % to 8.2 % (figure 4). Compared to control, the addition of MLF caused an increase in fat content. The results of the statistical analysis of fat showed no significant difference in the concentration of 5 % to 15 %. Increased fat content in cereal products was due to the presence of fat in MLF by 3.2 g 100 g^{-1} ingredients [6].

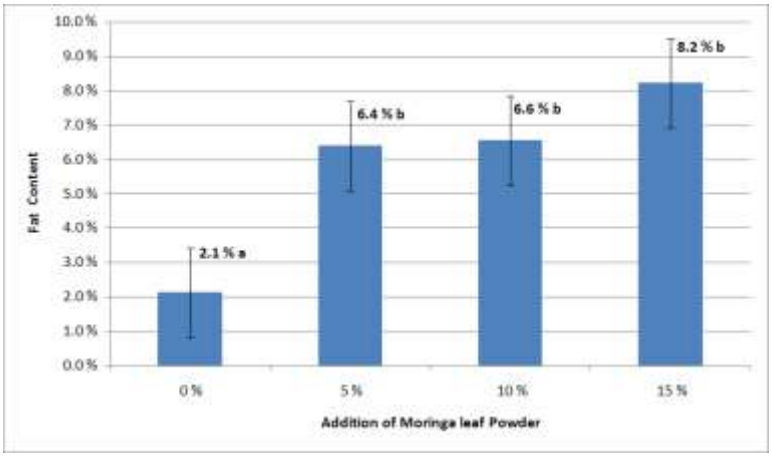

Fig. 4. Fat content of breakfast cereal products with addition of MLF

4 Conclusions

The addition of MLF in MOCAF flour had the potential to increase the nutritional value of breakfast cereal products. The addition of MLF with a percentage of 5 %, 10 %, and 15 % had a significant effect ($p < 0.05$) on water content, ash content, and fat content. The addition of MLF up to 15 % increases ash content by 2.79 % and fat content by 8.2 %.

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