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Physicochemical Characteristics of Composite Flour Made from Cassava, Sweet Potato, Corn and Rice Bran

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***Abstract*— Lampung province is one of production center for food commodities such as cassava, maize and sweet potato. The development of these commodities into processed products has been done one of which is a composite flour. The purpose of this study was to determine the physicochemical characteristics of composite flour consisting of a mixture of cassava flour (CF), sweet potato flour (SPF) and corn flour (NF). The study was conducted in the Laboratory of Lampung Assessment Institute for Agriculture Technology (AIAT) and Laboratory of Food Chemistry and Technology, Indonesian Legumes and Tuber Crops Research Institute (ILETRI) on May – July 2014. The design used was completely randomized by four treatments such as F1 (60% CF, 0% SPF, 35% NF, 5% Rice Bran/RB), F2 (50% CF, 10% SPF, 35% NF, 5% RB), F3 (40% CF, 20% SPF, 35% NF, 5% RB) and F4 (30% CF, 30% SPF, 35% NF, 5% RB), and the activities was repeated 4 times. The data were statistically analyzed and followed by Duncan Multiple range test. Physical characteristics observed were whiteness, water content, water absorption value (NPA) and the water solubility value (NKA). While the chemical characteristics of proximate analysis consist of moisture content, protein, carbohydrates, fat, fiber and ash content by AOAC Methods. The results showed that the whiteness value of four composite flours were not different in the ranged between 57.97% (F4) and 60.37% (F1). While the carbohydrates content ranged from 81.17 to 83.3% (the highest in the F4), protein was from 3.70 to 4.47% (the highest in the F4), fat was from 1.41 to 1.50%, ash content was from 01.47 - 1.66%, 1.81 - 2.17% for crude fiber, 11.64 to 18.80% for amylose, while amylopectin content ranged from 36.68 to 43.98%.**

***Keywords*— Physicochemical characteristics, composite flour.**

I. Introduction

An effort of food diversification in Indonesia was focused on reducing the consumption of rice and increases the consumption of non-carbohydrate sources of rice. These is done by the development of utilization of carbohydrate sources such as cassava, breadfruit, corn, sago, sorghum and tubers, and product development by manufacturing role to improve the taste and image of the typical Indonesian food products [1]. One of the efforts to strengthen food security and support the diversification of food that is by incessant government campaign diversification such as the manufacture of analogous rice that made from a mix local food, such as sweet potatoes, cassava, sago, and corn, reliable for strengthening food security, has the advantage of a lower glycemic index and higher nutrients by fortification process [2]. Usage non-rice carbohydrate sources such as sorghum, cassava, corn and sago has been used as a raw material in the manufacture of food products. In a study [3], analogous rice preferred by consumers is the formulation of 40% corn starch, 30% cassava flour or sorghum flour and 30% corn starch and sago palm. Usage cassava flour as a base for the manufacture of analog rice has the highest acceptance compared to other carbohydrate sources [4].

Therefore, analogous to the development of rice-based cassava flour and maize as local food can be an alternative staple food and increase the added value of local food. Thus, it needs to know the physical and chemical properties of the composite flour mix of cassava flour, sweet potato, corn and rice bran.

II. METHODOLOGY

A. Time and Place of Research

The study was conducted in Mai - July 2013 in AIAT Lampung laboratory and Laboratory of Chemical and Food Technology ILETRI, Malang.

B. Materials and Equipment

The equipment used in this study includes a set of flour making equipment, granulator, physical and chemical analysis equipment, and other support equipment. While the materials used were cassava, sweet potato, corn, rice bran, water, and chemical analysis materials.

C. *Experimental Design*

The experimental design used was a completely randomized design with four treatments of raw material formulations and four replications. The stages researches include making cassava, sweet potato, corn flour and flour mixing.

D. *Procedures*

Making flour from cassava, sweet potato and corn

Making CF, SPF and NF performed using hammer mill. The raw material was cleaned, peeled, washed, sliced (cassava and sweet potatoes), pressed and dried, then ground using a hammer mill.

Mixing Flour

Mixing flour as raw material for analog rice mix of was done according to formula in Table 1.

TABLE I
FORMULATION OF COMPOSITE FLOUR

Raw Material	F1	F2	F3	F4
CF	60%	50%	40%	30%
SPF	0%	10%	20%	30%
NF	35%	35%	35%	35%
RB	5%	5%	5%	5%

1) *Determination of physical and chemical characteristic*: The analysis was conducted at the Laboratory of Food Chemistry and Technology, ILETRI, Malang. Physical analysis was conducted on the whiteness, moisture content by AOAC method [5], water absorption value (NPA) and the water solubility value (NKA). While the chemical analysis of the proximate analysis such as protein, carbohydrates, fat, ash and fiber content analysis by AOAC method [5].

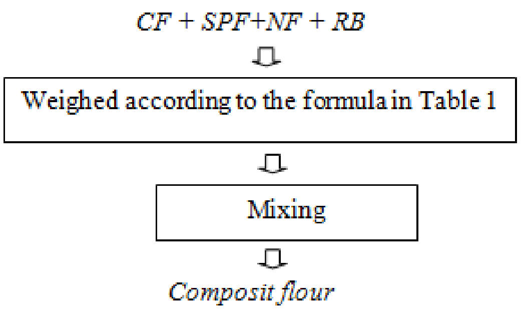

Fig. 1. Flow chart of composite flour processing

E. *Data analyses*

Data collected was analysis of variance than separated using Duncan multiple range test.

III. RESULTS AND DISCUSSION

A. *Preparation of CF, SPF, NF and RB*

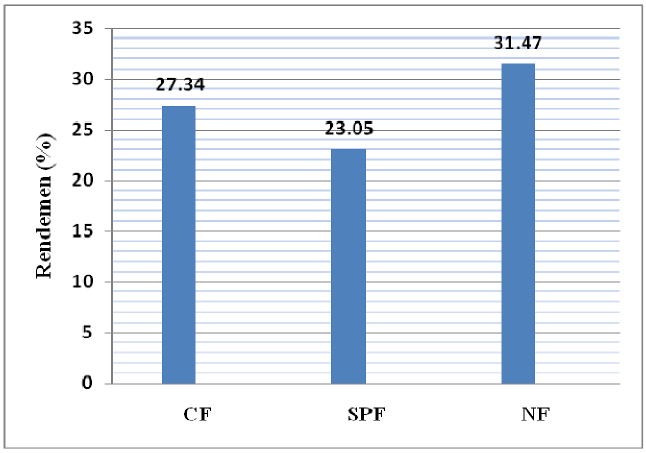

Fig. 2 Rendemen cf, spf and nf

CF and SPF were made by the method of dry milling by stages of stripping, washing, slicing, drying, and flouring. While NF was made by wet milling method by stripping phase separation of the epidermis and seed agencies, downsizing, soaking, draining and flouring. NF was made by the same method and produces a rendemen of 31.47%. This value was greater compared CF and SPF, which was 27.34% and 23.05% on 80 mesh screen (Figure 2). In addition flouring method, the amount of rendemen was also influenced by varieties and harvesting time.

B. *Physicochemical characteristics of CF, SPF, NF and composite*

1) *Whiteness*: The whiteness on CF, SP The results showed that CF has the highest whiteness (77.13%) and RB has the smallest (28.23%). While flour composites showed the four Formulas was not different and range from 57.97% (Formula 4) to 60.37% (Formula 1).

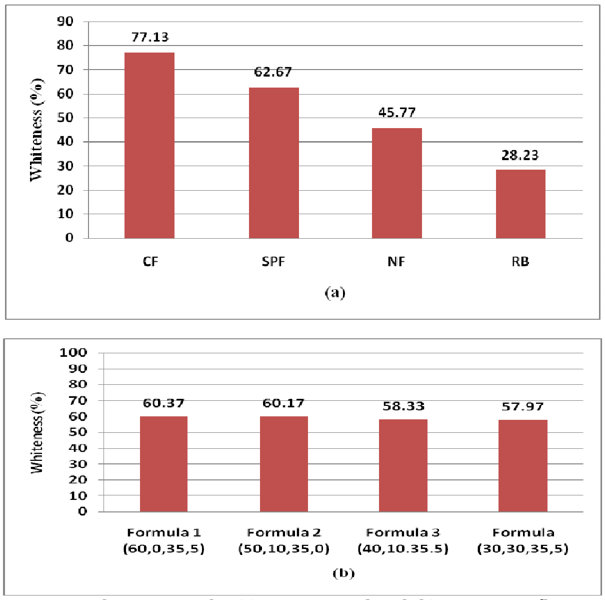

Fig. 3 Whiteness on the (a) raw material and (b) composite flour

C. Water Content, Water Absorption and Water Solubility Values

Wet milling method in the manufacture of NF, affected the water content flour. Results showed the highest levels of NF (13.81%). Figure 4 shows the water content and water solubility, while Figure 5 shows the rate of water absorption on flour and composite flour. The lowest water content (9.21%) was belong to Formula 4.

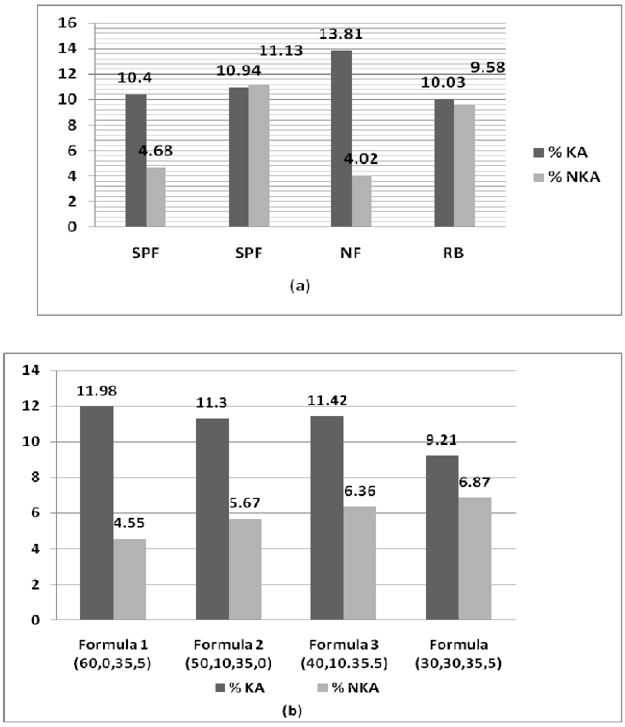

Fig. 4 Water Content and NKA on (a) the raw material and (b) composite flour

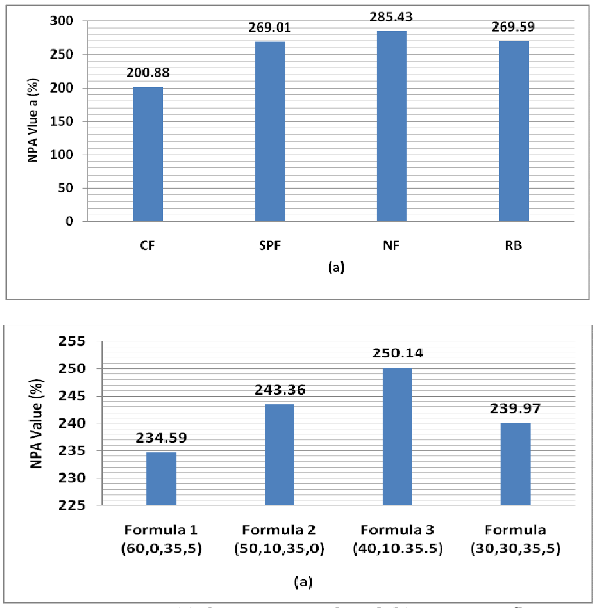

Fig. 5 NPA on (a) the raw material and (b) composite flour

The amounts of water added to the starch greatly affect the physical properties of starch. Composite flour have water solubility value of 4.55 to 6.87%, the highest in Formula 4 and have absorption values from 234.59 to 250.14, and the highest was the Formula 3. This indicated the molecular structure of starch from composite flour have been damaged, so that the material easily soluble in water. The higher NKA of the material, the material easily soluble in water [6].

D. Crude fiber, Amylose, and Amylopectin

Fiber brings many benefits to the body. Among other things such as preventing constipation, cancer, minimize the risk of illness in the large intestine, helps lower cholesterol levels, help control blood sugar levels, prevent hemorrhoids and help lose weight.

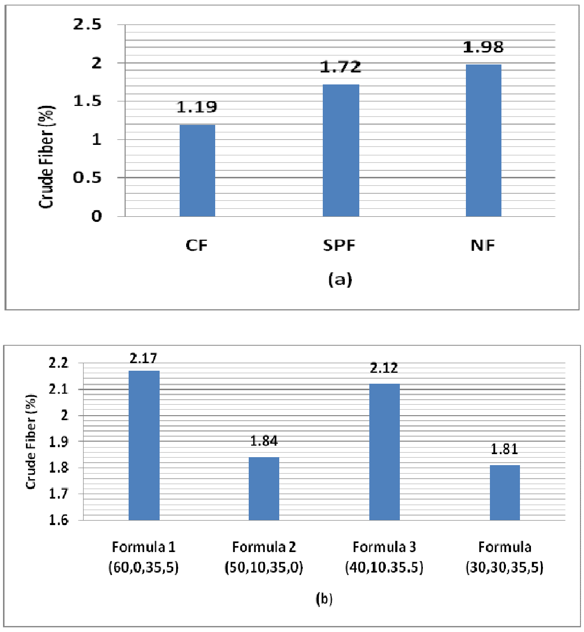

Fig. 6 Crude fiber on (a) the raw material and (b) composite flour

Starch consists of two fractions which be separated by hot water. Soluble fraction mainly composted by amylose, and insoluble composted by amylopectin. In amylopectin food products is stimulating the process of blooming (puffing). Food products derived from starch by high amylopectin will be light, crisp and crunchy. While starch by high amylose, tend to produce a hard, solid.

The results of the analysis of crude fiber, amylose, and amylopectin on CF, SPF, NF and flour composites are shown in Figure 6 and 7.

Starch composition generally consists of amylopectin as the biggest and the rest of amylose [7] which have properties different natural that 10-20% for amylose and 80-90% for amylopectin. Most of the natural starches such as corn starch, wheat, tapioca, potato and sago contains a high percentage of branching chains of amylopectin [8] [9].

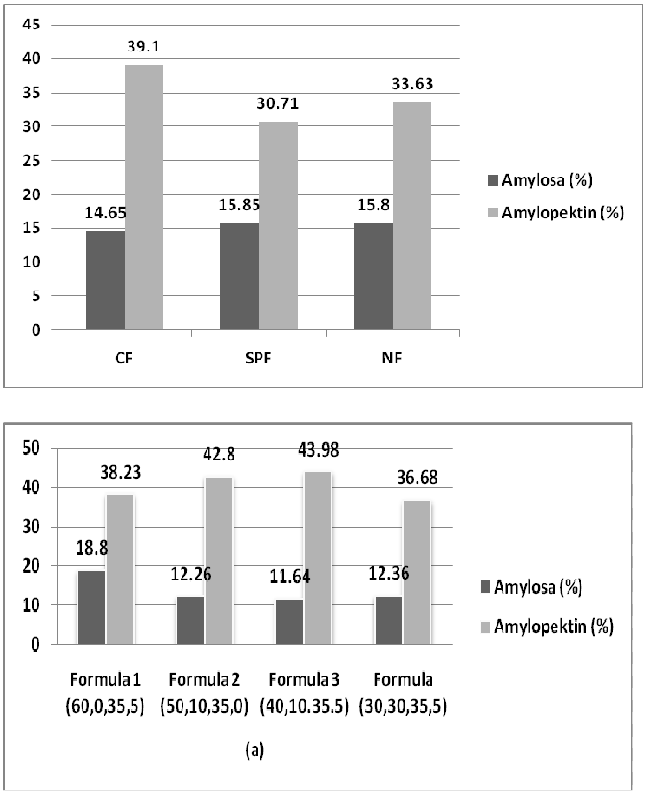

Fig. 7 Amylose and amylopectin on (a) the raw material and (b) composite flour

E. Proximate analysis

Proximate analysis is a chemical test to determine the nutrient content in the form of protein, carbohydrate, fat, and fiber in a food substance from food or feed. Proximate analysis has benefit of a quality assessment of feed or foodstuffs, especially on the standard of food substances that should be contained in it. A proximate test result on composite flour is shown in Figure 8.

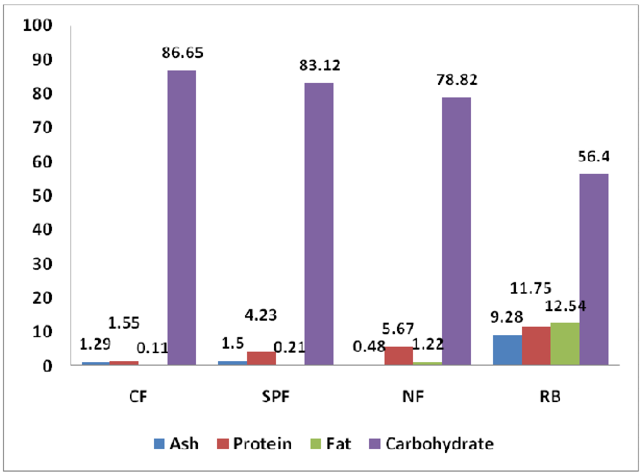

Fig. 8 Results of the proximate analysis in CF, SPF, NF and RB

The highest carbohydrate content was 86.65% (CF) and the lowest was 56.4% (RB), and otherwise the highest protein was 11.75% (RB) and the lowest 1.55% (CF). Cassava is one of the highest sources of carbohydrates and can be used as an alternative source of carbohydrate.

TABLE III
CHEMICAL CHARACTERISTICS OF SOME RICE VARIETIES

Rice Varieties	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Formula 1	1.66	3.70	1.51	81.17
Formula 2	1.48	3.91	1.41	81.89
Formula 3	1.47	4.48	1.02	81.62
Formula 4	1.57	4.47	1.42	83.33

Table II shows that the ash content, protein, fat, and carbohydrates from the four formulas were not significantly different. However, the addition of RB in the flour composites can increase protein and fat content of in each formula, thus enriching the nutritional value of food products made from composite flour. Composite flour of Formula 4, on average, has the highest proximate value so well for use as composite flour.

IV. CONCLUSIONS

Cassava flour have the highest whiteness value was 77.13% and the smallest in the rice bran of 28, 23%. Whiteness level of composite flour are not signifivantly different, in the range of 57.97% to 60.37%.

The addition of rice bran to the composite flour can increase the protein and fat content.

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