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Substitution of Cowpea with Soyflour/Cassava Starch in Moin-Moin Preparation

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Abstract: Moin-moin is usually prepared from cowpea which is prepared into an emulsion to which ground tomato, onions and condiments are added. It is then steamed to form a gel. Attempts to make moin-moin from 100% soybean resulted in a non cohesive gel when steamed. Attempts are therefore made in this study to incorporate starch into soyflour and study its effects on some physico-chemical properties of the mixture. Soaked blanched soybeans were dried at a reference temperature of 40°C and between 60 and 100°C. Samples were taken at 1 hr intervals during drying, dehulled and milled. Functional properties known to affect moin-moin were determined. Three sets of moin-moin samples were prepared for taste panel evaluation. The first set was produced from flours obtained by drying at 40°C for 24 h, milled in two and three passes and cassava starch was incorporated between 0 and 30% levels. The second set was produced from flours obtained by drying at 40°C, milled in 1-5 passes to produce flour differing in particle size distribution and substituted with 20% starch. The third set was prepared from flour produced by drying between 40 and 100°C, milled in 4 passes and incorporated with cassava starch at 20% levels. The heat treatment applied to the seeds decreased functional properties like hot water absorption, swelling capacity but increased the least gelling concentration. Moin-moin of good organoleptic qualities was produced from seeds dried at between 40 and 80°C, milled in four passes and substituted with cassava starch at 20 and 25% levels.

Key words: Cowpea, soybean, moin-moin, soyflour

INTRODUCTION

The availability of high protein foods is a subject of great concern to many Third World countries such as Nigeria. In recent years, uneven distribution of food coupled with increasing population have worsened the situation. Soybean has great potential to improve the nutrition of people in Africa, because of its high protein and oil contents[1,2]. The main staple food items in Africa are the grains (rice, sorghum, millet and maize) and the tubers (cassava, yams and sweet potatoes) FAO[3]. The protein content of these are low and in the face of insufficient animal protein in the diet, a good plant protein substitute is imperative. Cowpeas have largely served this need especially in the diet of the people of West Africa. However, soybeans are by far superior to cowpea in nutritive value as far as protein content and amino acid composition are concerned[4].

Realising its nutritional value and economic importance, many have suggested methods of utilizing soybeans for human consumption in Nigeria. Ogundipe[5] and Osho[1] reported an improvement in the nutritional quality of moin-moin (steamed cowpea paste) when cowpea is supplemented with soybean. Moin-moin is a very popular product in Nigeria. It is eaten by all segments of the population except infants Adeniji and Potter[6]. Traditionally, the preparation of the paste is done by the combined process of soaking, dehulling and wet-milling. This is both time consuming and labour intensive[7]. These requirements and urban pressures have diminished the consumption of moin-moin in recent years[6]. Therefore, the production of a flour with optimal functional properties which can easily be converted into paste by the addition of water will be of considerable advantage. Attempts to make moin-moin from 100% soybean resulted in a non-cohesive gel when steamed. Attempts are therefore made in this study to produce soyflour of optimum functional properties and to investigate whether good quality moin-moin can be produced from soyflour when cassava starch is incorporated into it.

MATERIALS AND METHODS

Soybean seeds (Tax-1440-IE) were obtained from International Institute of Tropical Agriculture (IITA),

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Ibadan. Fresh cassava tubers were obtained from teaching and research farm, Obafemi Awolowo University, Ile-Ife. Groundnut oil was purchased from Foodco Supermarket in Ibadan. Black eye-Kano white cowpea seeds, onions, salt, red pepper were purchased from a local market at Ile-Ife.

Preparation of soyflour for functional properties determination: Sound white soybeans were soaked in tap water for 21/2 h and then blanched at 60°C for 3 h. The seeds were dried at varying temperatures between 40 and 100°C in a convectional air-oven (Model OV-440) for a period of 0-4 h. Samples were taken from the oven at 1 h interval, dehulled manually if wet and mechanically if dried and then milled in a pin disc mill in three passes.

Functional properties determination: Hot water absorption was determined by the centrifuge method of Sosulski[8]. Swelling capacity was determined by the method of Lin, Humbert and Sosulski[9] and least gelling concentration was by the method of Sathe and Salunkhe[10].

Particle-size determination for flours: The particle size distribution of the flours was determined by placing 50 g defatted flour on a tier of sieve (Endecotts laboratory test sieves) arranged on an Endecotts test sieve shaker with sieves of decreasing pore diameter as follows: 1180, 850, 425, 300, 212, 150, 75 and 63 μm pore diameter sieve. The sieve shaker was operated for a duration of 10 min in each test. Percentage particle retention on each sieve was determined. The results represent the mean of three determinations.

Production of flour samples for moin-moin: Three sets of flour samples were produced. The first set was produced by drying soybean seeds after soaking at a temperature of 40°C for 24 h, milled in three passes. Cassava starch was added to the resulting flour at different levels of 0, 5, 10, 15, 20, 25 and 30%.

The second set was produced by drying at 40°C, milled in 1-5 passes through a pin-disc mill. Each of the five samples was collected to correspond with the end of a milling pass and each flour sample was substituted with 20% cassava starch. The third set was produced by drying at temperatures between 40 and 100°C, milled in three passes and substituted with 20% cassava starch.

Moin-moin preparation: There are no literature values for ingredient composition of moin-moin prepared from soyflour. An acceptable composition after a series of preliminary trials was formulated. Moin-moin prepared from cowpea flour which served as control was prepared by the modified recipe and method of Onuorah[11] as shown in Table 1 and Fig. 1.

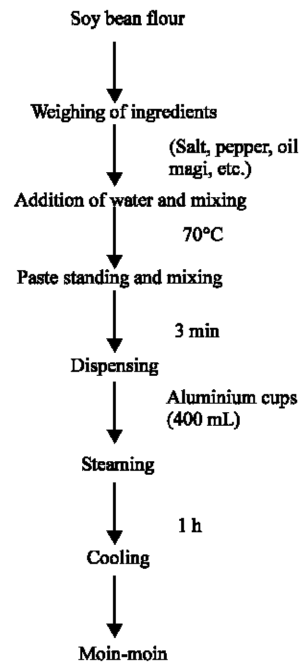

Fig. 1: Flow sheet of the preparation of moin-moin

Table 1: Moin-moin recipe

Ingredients	Moin-moin	Moin-moin
Flour	50 g*	50 g**
Red pepper	6 g	6 g
Onions	6 g	6 g
Salt	2.0 g	2.0 g
Water	125 mL	140 mL
Oil	10 mL	17 mL
Maggi cube	0.25 g	0.4 g

* Soyflour plus appropriate level of cassava starch to make 50 g, ** Cowpea flour only

Sensory evaluation: Three sets of moin-moin samples were produced from the three sets of flour produced earlier. The evaluation was carried out at three different sessions by a 10-member panelist. The panelists were selected based on their familiarity with moin-moin and their ability to differentiate effectively between one sample and another. All the three sets of moin-moin samples were evaluated organoleptically using a 7-point hedonic scale. Samples were scored for structure, texture, flavour and overall preference. In all studies, the maximum score was 7 and the minimum was 1. The sensory scores obtained for each set of moin-moin samples were subjected to analysis of variance (ANOVA) to determine if there were statistically significant ($p \leq 0.05$) differences in the sensory attributes[12]. Turkey's test was used to determine which of the samples were significantly different[13].

RESULTS AND DISCUSSION

Functional properties: Water absorption of soyflour produced from the dried soybean seeds decreased with increasing temperature and time of drying, as shown in Fig. 2. The decrease is more pronounced at higher temperatures (90 and 100°C). The decrease in water absorption may be attributed to predenaturation of protein and alteration of cell wall materials during drying of soaked seeds. According to Joslyn[14,15], water absorption of proteins in food is markedly decreased by protein aggregation and precipitation which may occur spontaneously following denaturation of proteins.

The swelling capacity of soyflour as a function of heat treatment is illustrated in Fig. 3. It was observed that the swelling capacity of soyflour also decreased with increasing temperature used for drying the soybean seeds. It had been reported that the ability of flour to swell depend largely on its starch granules and proteins and that the ability of starch and protein to swell is adversely affected by both thermal and mechanical damage occurring during manufacture[7]. However, the low values obtained for soyflour as compared to that reported by Enwere and Ngoddy[7] for cowpea may be attributed to the low level of starch in soybeans.

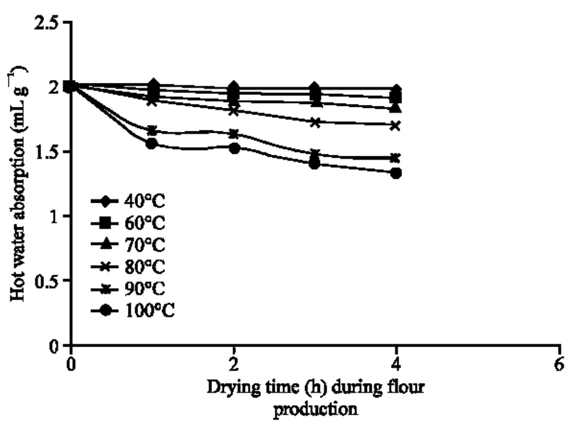

Fig. 2: Water absorption capacity of soyflour as a function of heat treatment

Table 2: Particle size distribution of soyflour studied

Sieve diameter in µ	Percentage of particles retained on the sieve for the soyflour milled in 1-5 passes through pin disc mill				
	1	2	3	4	5
1180	27.82	7.53	3.10	2.50	2.00
850	2.17	1.19	0.88	1.06	1.28
425	30.73	29.65	20.76	15.09	18.26
300	13.46	16.94	20.38	17.86	10.53
212	6.09	10.11	11.03	13.60	16.30
150	4.67	5.94	6.09	9.89	9.40
75	6.41	12.15	12.03	17.50	20.89
63	3.61	11.53	12.96	15.92	15.27
Collector	0.56	2.46	4.56	2.41	1.03

* Loss of flour particles to the sieve and as dust accounted for the difference between the sum of figures in each column and 100%

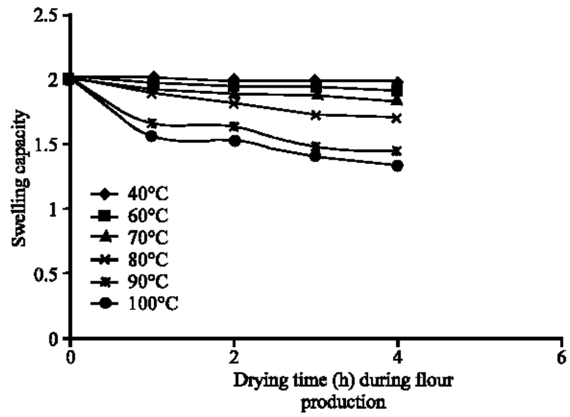

Fig. 3: Swelling capacity of soyflour as a function of heat treatment

Table 3: Particle size-distribution of the soyflours in the range 75-300 and 63-212 µm, respectively

No. of milling passes	% Particles distributed between 75-300 µm	% Particles distributed between 63-212 µm
1	30.63	20.78
2	45.14	39.73
3	49.53	42.11
4	58.85	56.91
5	73.12	63.86

The least gelling concentration increased with increasing drying temperature starting from 60°C after 3 h of drying as shown in Fig. 4. However drying at the reference temperature of 40°C for 24 h and at 60°C for 2 h did not cause any change in the least gelling concentration. Drying at a temperature of 70°C for 3 h increased the least gelling concentration from 18% (dwb) to 26% at 100°C after 4 h of drying. The increase in the least gelling concentration that is, the decrease in the ability of soyflour to form stable gels, is attributed to denaturation, aggregation and precipitation of proteins[15].

Particle-size analysis of soyflour derived from multiple milling: The percentage particle size distributions of the soyflours resulting from one to five milling passes through a pin disc mill are shown in Table 2 and 3. The flour particles in the range 75-300 µm increased consistently reaching a maximum of 73.12% after five passes. Similarly, the flour particles in the range of 63-212 µm also increased consistently reaching a maximum of 63.86% after five passes. The 425 µm sieve received the highest quantities of flours 30.73, 29.65, 20.76% in the first, second and third passes respectively. After the third pass, the 75 µm sieve retained 17.50 and 20.89% flours in four and five passes, respectively.

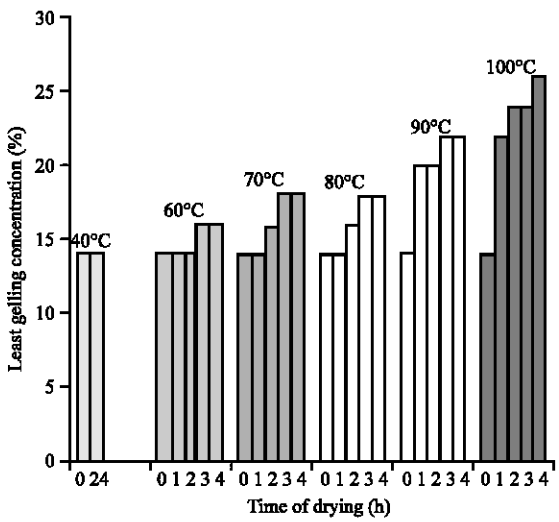

Fig. 4: Least gelling concentration of soyflour as a function of heat treatment

Table 4: Mean sensory scores for the moin-moin samples prepared from soyflour milled in four passes and mixed with different levels of cassava starch

Sensory quality	Control	Moin-moin Samples* A	B	C	D	E	F	G+	LSD**
Structure	6.2^{a}	2.3^{b}	2.5^{c}	2.5^{d}	3.0^{e}	5.9^{a}	5.9^{a}	5.6^{a}	
Texture	6.4^{a}	2.0^{b}	2.1^{c}	2.1^{d}	2.5^{e}	5.8^{a}	5.7^{a}	5.5^{a}	
Flavour	6.0^{a}	4.9	4.8	5.0	5.5	5.6	5.4	5.2	NSD***
Overall preference	6.2^{a}	1.6^{b}	1.8^{c}	1.9^{d}	7.0^{e}	5.9^{a}	5.8^{a}	5.6^{a}	0

* Control: Cowpea flour, A:100% soyflour, B:95% soyflour +5% cassava starch, C:90% soyflour +10% cassava starch, D:85% soyflour +15% cassava starch, E:80% soyflour +20% cassava starch, F:75% soyflour +25% cassava starch, G:70% soyflour +30% cassava starch, ** Least significant difference ($p \leq 0.05$), *** No statistically significant difference ($p \leq 0.05$) because calculated F-ratio through analysis of variance (ANOVA) < tabulated F-ratio + Means with the same letter within rows are not significantly different ($p \leq 0.05$)

Table 5: Mean sensory scores for the moin-moin samples prepared from soyflour obtained by milling in one to five milling passes

Sensory quality	Control	Moin-moin samples+ 1 MPx	2 MP	3 MP	4MP	5MP	LSDxx
Structure	6.0^{a}	2.2^{b}	2.8^{c}	5.4^{a}	5.6^{a}	5.5^{a}	
Texture	6.1^{a}	2.1^{b}	3.2^{c}	5.3^{a}	5.7^{a}	5.5^{a}	
Flavour	6.2	4.9	5.0	4.9	5.2	5.2	NSDxxx
Overall preference	6.1^{a}	2.4^{b}	3.6^{c}	5.7^{a}	5.9^{a}	5.4^{a}	

x-Milling passes, xx-Least significant difference ($p \leq 0.05$), xxx-No statistically significant difference ($p \leq 0.05$) because calculated F-ratio through analysis of variance (ANOVA) < tabulated F-ratio, + -Means with the same letters within rows are not significantly different ($p \leq 0.05$)

Sensory evaluation: The mean sensory scores as well as the analyses of the scores for the moin-moin samples at the first, second and third panel sessions are as shown in Table 4, 5 and 6. The taste panel sessions were organized to establish the optimum conditions of variables necessary for the production of good quality moin-moin product, with the results of optimum level of addition of cassava starch and milling passes guiding the next set of experiment.

Table 6: Mean sensory scores for the moin-moin sampls prepared from soyflour obtained by drying at varying temperatures between 40 and 100°C

Sensory quality	Control	Moin-moin samples+ A(40 °C)	B(60 °C)	C(70 °C)	D(80 °C)	E(90 °C)	F(100 °C)	LSDxx
Structure	6.1^{a}	5.7^{a}	5.6^{a}	5.7^{a}	5.7^{a}	3.5^{b}	2.6^{c}	
Texture	6.2^{a}	5.9^{a}	5.8^{a}	5.9^{a}	5.8^{a}	3.1^{b}	2.3^{c}	
Flavour	6.0^{a}	6.0	5.9	5.8	5.9	5.6	5.7	NSDxxx
Overall preference	6.2^{a}	6.0^{a}	5.8^{a}	5.7^{a}	5.8^{a}	3.3^{b}	2.8^{c}	

x- Seed drying temperature, xx- Least Significant Difference ($p \leq 0.05$), xxx- No statistically significant difference ($p \leq 0.05$) because calculated F-ratio through analysis of variance (ANOVA) < tabulated F-ratio. +- Means with the same letters within rows are not significantly different ($p \leq 0.05$)

The addition of starch to soyflour used in the production of moin-moin has substantial effect on the structure as well as the texture of the samples. At low level of starch (≤15%), the structure was described as being heterogenous and the gelling capacity of the resulting flour was very low leading to a non-cohesive gel. This perhaps informed the low mean scores returned by the panelists with respect to structure and textgure. At higher starch level (≤20%), the gels were firm and cohesive. Addition of 20% starch to soyflour was most preferred among samples even though the other samples (25 and 30%) were not significantly different even from the control sample. Flavour was not affected perhaps due to the processing method employed in the preparation of the flour and the masking effect provided by other ingredients such as spices.

Similarly, milling also affected both the texture and structure and subsequently the overall preference for the product. Milling in one and two passes produced very gritty moin-moin which was disliked by the panelists. Milling in four passes received the highest score with respect to structure and texture and this was finally reflected in the panelists scores for the sample Table 5.

Seed drying temperatures of between 40 and 80°C produced moin-moin samples that compared well with the control sample. Seed drying temperature above 80°C markedly adversely affected the quality of moin-moin. The panelist scores quite agreed well with the results of functional properties earlier determined.

CONCLUSION

This finding has revealed that moin-moin of good organoleptic qualities can be prepared from soyflour when soybean seeds are dried at temperatures between 40 and

80°C, milled in four passes through pin-disc mill and substituted with 20% cassava starch.

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