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Research Article

Evaluation of the effect of inclusion of cocoa powder on yield, colour and proximate composition of '*beske*'- a tofu-like cheese, made from soyabean milk

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Abstract

Choco-soy cheese ('Beske') was made by fortifying soya milk (SoM) with cocoa powder (CoP) at 0-7.5%, representing the percentages of cocoa powder in the samples. The percentage yield, colour analysis and proximate composition of the produced choco-soy 'beske' were carried out using standard procedures. The percentage yield increased from 6.50% to 8.00% across all inclusion levels of cocoa powder. Significant difference ($p<0.05$) exists in L* (degree of darkness) values of sample B. Yellowness, b*, showed a downward trend, 8.89, 4.65, 4.24 and 4.13 in all. The result of total different colours, ΔE, in the choco-soy cheese showed that significant difference exists between sample B and others. Difference ($p<0.05$) exists in protein, crude fat, and total ash contents which increased from 4.34% to 5.47%, 16.76% to 26.90% and from 16.15% to 17.44% respectively as the inclusion level of cocoa powder increased. Total carbohydrate decreased as cocoa powder inclusion level increased.

Keywords: Cocoa powder, Beske, Yield, Colour, Proximate composition.

INTRODUCTION

Cheese, a concentrated dairy commodity, either of animal origin or plant origin, is produced by a combination of activities including acid or rennet coagulation or curdling milk, stirring and heating the curd, draining off the whey, collecting and pressing the curd. The cheese is ripened, cured, or aged to develop the flavour and texture (Ayodeji et al., 2020, Balogun et al., 2016, Lawal & Adedeji, 2013). According to Bodyfelt et al. (1988) cheese is a dairy product made by coagulating either whole milk, part-skim (low fat) milk, skim milk, or cream by removing much of the liquid portion while retaining the coagulum and the entrapped milk solids.

Among the sources of vegetable milk, soybean has received very high research attention (Sun-young et al., 2000). Other vegetable source of milk includes melon seeds, water melon seeds, *Colocynthis vulgaris* (Oyenuga and Fetuga 1975; Lawal & Adedeji, 2013), Tiger nuts, *Cyperus esculentus* (Umelo et al, 2014), coconut, *Cocos nucifers* (Balogun et al., 2016).

'Beske' is consumed in its fresh unripened state, fried or used as a meat-analogue in stews and soups. 'Beske' is an excellent source of protein, fats and minerals such as calcium, iron and phosphorus, vitamins and essential amino acids, thus making it an important food in the diet of both old and young (Oladipupo & Jadesimi, 2012). Cheese made from animal milk is a very good source of animal protein, fat, carbohydrates, ash and moisture and a good source of sodium, potassium and Calcium (Omotosho et al., 2011). When it is of plant origin, such as soyabean (*Glycine max*), it also has a very rich nutritional profile.

Cocoa, Theobroma cacao, has been widely used in varying applications. Chocolate has been consumed as confection, aphrodisiac, and folk medicine for many years before

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science proved its potential health benefits (Ackar et al., 2013). Cocoa beans are one of the best known sources of dietary polyphenols; the total polyphenol content of the dried fat-free-mass of fresh cocoa beans is around 15-20% and of fermented beans approximately 5% (Wollgast & Anklam 2000). The polyphenol content in cocoa beans depends on their origin and processing, as they are subject to a combination of fermentation and drying treatments, followed by alkalisation and roasting, which affects the polyphenol content and consequently the end product quality (Hii et al., 2009).

Since cheese of animal origin is costly and rare to come by in developing nations, coupled with its low vitamins C and mineral content, milk were sought from plant origin. This made milk readily available and accessible for the teeming population and her nutrition need. Still, due to effect of processing, milk of plant origin lack capacity to provide adequate mineral content and antioxidants need of the populace. Continous search in solving these nutritional deficiencies or gap prompted more research to improve the quality of cheese made from these raw materials. The objective of this project therefore, is to increase utilization of cocoa (cocoa powder) in cheese making, improve presentation and nutritional composition of 'beske', an unripened cheese (tofu-like cheese).

MATERIALS AND METHODS

Well dried and clean soyabeans was obtained from Oja Oba market in Ibadan while cocoa powder was supplied by the marketing department of CRIN, Ibadan, Nigeria. Alum was obtained from open market in Ibadan and five percent concentration was prepared.

Production of soyabean milk

Dry, cleaned soyabeans was measured and soaked in process water at a ratio of 1:3 w/v for about six hours for rehydration. Rehydrated beans were dehulled manually before wet milling was done with a Veronica Expert commercial grinder 2JARS, 1.6HP (India). Filteration was done through a double-layered muslin cloth, and manually squeezed with a twisting motion to extract most of the milk. The extracted emulsion was pasteurized and stored at 30°C before the production of cheese and used within 24 hours of production.

Production of choco-soy-cheese blend

The portion of the sieved soya milk for 'beske' production was measured. The variation in the measurement was done according to the method described by Igyor et al. (2006). 'Beske' samples were produced from 1000 mL of soyabean milk with cocoa powder added at varying proportions, to create a ratio of (CoP : SoM) 0:100; 2.5:97.5; 5:95; and 7.5:92.5 (w/w). Alum solution was used as a coagulant. 20 mL of the 5% w/v (5 g in 100 mL distilled water) alum solution was added to each of the milk blends. The method of Ashaye et al. (2006) with some modifications was used to produce the tofu-like cheese. Soyabean milk with cocoa powder blend was transferred into a metal pot. The pot was placed over a slow burning fire and heated till it starts boiling. The milk was kept at the boiling point and the coagulant (20 mL alum solution) introduced until it coagulated and there was a visible separation of curds and whey. The curds and whey were then poured into a clean muslin cloth and the whey was allowed to drain. After a few minutes, the formed curd was placed in a clean container and cut to desired shapes. The cut curd were fried in hot vegetable oil (light frying), allowed to cool and packed in clean air permeable wrappers prior storage on a shelf at room temperature.

Determination of Percentage Yield

The yield was determined by a method described by Igyor et al. (2006). The yield of warankashi from the soyabean milk and cocoa powder blends or mix was determined by the calculation as follows:

Yield of warankashi (%) = $\frac{X_2}{X_1} \times 100$

Where: X1 = weight (gram) of soyabean milk/cocoa powder used and X2 = weight (g) of warankashi (either from blends or whole milk) produced (assume 1 gm =1 ml).

Colour Analysis

Colour determination for each sample of produced choco-soy cheese was measured according to the method described by Alamu and Adesokan, 2020. Chroma meter, model CR 410, Konica Minolta with serial number B 8407450 (Minolta, Osaka, Japan). The Lab values followed the Hunter Lab color scale. Readings were done in triplicates.

Proximate Analysis

The standard method as described by association of analytical chemists (AOAC, 2000) was used for the analysis of percentage protein, crude fat, ash content, crude fiber, and moisture content. Moisture content was determined after drying at 103 ºC until a constant weight was attained. Protein was determined by the Kjeldahl method (N x 5.84), crude fat was extracted with petroleum ether using Soxhlet apparatus (gravimetric method), ash (gravimetric method), while total carbohydrate quantity was determined by the differences: % carbohydrate = 100- (% protein + % fat + % ash + % crude fiber + % moisture).

Statistical Analysis

Data obtained, in triplicate, were statistically analysed using SPSS version 20.0; analysis of variance (ANOVA), were used to determine the differences at 5% level of significance. In cases where differences occurred, the means was separated using Ducan test.

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RESULTS AND DISCUSSION

The percentage yield of soy beske with varying inclusion level of cocoa powder was presented in **Figure 1**. Results showed a significant ($p<0.05$) increase in percentage yield of cheese samples from 6.50% in control sample (100% soya milk) to 8.00% for the cheese produced with 7.5 : 92.5 (CoP : SoM) proportion of cocoa powder-soya milk mix. This result agreed with the increasing trend reported by Adedokun et al. (2013) who researched on composite cheese made from soya milk and bambara milk. Although, yield of cocoa-soy-cheese was smaller compared with values (28.05% – 41.11%) reported for soy-bambara cheese (Adedokun et al., 2013), (26.71% - 13.55%) cow-coconut cheese (Balogun et al., 2016) and (30.50% - 15.50%) cow-soy cheese (Igyor et al., 2006), this finding implied that percentage yield might be a function of the level of available protein for curdling by enzyme or acid (**Table 1**).

Colour showed there was no significant difference ($p<0.05$) in L* values of samples A, C and D whereas, difference exists in L* value of B. Greenness (a*) was highest in sample B (-2.91) and least in samples C and D. Yellowness (b*) was highest in control, A. About fifty percent reduction in b* value was observed between 'beske' labeled A and other choco beske samples. This revealed the impact of cocoa powder addition in the choco-soy beske. Yellowness (b*) decreased with increased cocoa powder addition. ΔE was not significant in all the samples except for sample B. Cheese with 2.5% (B) cocoa powder addition was brighter and more transparent than control, (A). The results obtained for the proximate compositions of the samples were significantly different at 95% confidence level (**Table 2**). The significant difference observed was primarily due to the interaction of cocoa powder with the soya milk used in cheese making. There was an increase in moisture content in all the choco-

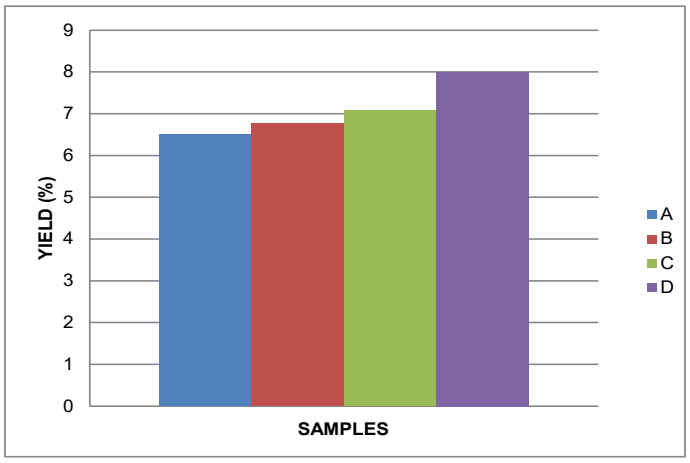

Figure 1: Percentage yield of choco-soy beske.

Values are means of triplicate determination

Legend: A (0 : 100), B (2.5 : 97.5), C (5 : 95), D (7.5 : 92.5)

Table 1: Colour parameters of choco-soy cheese ('Beske').

Sample	L*	a*	b*	ΔE
A	45.44^{a}	-3.61^{b}	8.89^{a}	33.38^{a}
B	39.92^{b}	-2.91^{a}	4.65^{b}	27.13^{b}
C	46.13^{a}	-4.30^{c}	4.24^{b}	33.38^{a}
D	45.92^{a}	-4.28^{c}	4.13^{b}	33.17^{a}

Values are means of triplicate determination, abcd Values in the same column bearing different superscripts are significantly different ($p<0.05$). A (0:100), B (2.5:97.5), C (5:95), D (7.5:92.5). L value indicated reduced darkness, a* indicates greenness, b* value suggested increasing yellowness and ΔE represents total different colours.*

Table 2: Proximate composition of choco-soy cheese ('Beske').

Sample	Moisture(%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Carbohydrates (%)
A	18.00^{c}	16.76^{d}	16.15^{b}	0	4.34^{c}	44.75^{a}
B	26.48^{a}	21.48^{c}	17.37^{a}	0	5.10^{b}	29.57^{b}
C	25.69^{a}	23.87^{b}	17.28^{a}	0	5.39^{a}	27.77^{c}
D	23.15^{b}	26.90^{a}	17.44^{a}	0	5.47^{a}	27.04^{c}

Values are means of triplicate determination, abcdValues in the same column bearing different superscripts are significantly different ($p<0.05$).

Legend: A (0 : 100), B (2.5 : 97.5), C (5 : 95), D (7.5 : 92.5).

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soy cheese samples analysed. The percentage moisture of 18.00% which was the least was observed in the control sample (A; 100 % soy-cheese) and while sample B had the highest moisture content. (CoP : SoM, 2.5 : 97.5), 26.48 and thereafter declined for sample C (25.69) and sample D (23.15). There was no significant difference in moisture content of cocoa soy cheese blends B and C. The protein content of the choco-soy cheese blends (**Table 2**) ranged from 16.76% - 26.90%. Sample A had the lowest level of crude protein content, while the highest crude protein content was recorded in sample D. Thus, protein content of choco-cheese increased with increased level of cocoa powder.

Crude fat level ranged from 16.15% - 17.44%.The lowest crude fat content (16.15%) was observed in the control sample (A), while the rest were not significantly different from one another. Fat is important as a source of energy in the human body (Onyeka, 2008). The impact of light frying on the cocoa-soy cheese could partly be responsible for the moderate fat density in the cocoa-soy tofu-like cheese ('Beske').

The ash content in a food material is a measure of mineral elements in food (Balogun et al., 2016). It shows a positive increasing trend with the minimum ash result being 4.34% and highest ash content recorded being 5.47%. This further affirmed the fact that varying the inclusion levels of cocoa powder in 'beske' was responsible for high mineral content of the produced tofu-like cheese. Choco-soy beske blends C and D were not significantly different ($p<0.05$) but different from blend B and the control (A).

Total carbohydrate in choco-soy cheese blends ranged from 44.75% - 27.04% among products with added cocoa powder. Control sample had a value of 44.75%. There was significant difference ($p<0.05$) among the choco-soy 'beske' samples. As cocoa powder addition increases, total carbohydrate content decreases in 'beske'. This result agreed with the position of Balogun et al. (2016), as carbohydrate decreased with increasing substitution of cow-soya cheese.

CONCLUSION

This study show there was an increase in yield, protein, fat, and ash level as cocoa inclusion increased. Also, total carbohydrate decreased as inclusion level of cocoa powder increased. This therefore presents the possibility of creating a new product, cheese analogue, for the populace. The nutritional value discovered in producing 'beske' by inclusion of cocoa in soya milk blends will improve the well being of the populace from Nigeria and other developing nations. Lastly, cocoa can be utilized in making functional cheese for categories of people regulating their carbohydrate intake. This can be served as a snack food or component of a meal.

DECLARATION OF INTEREST

There was no conflict of interest in the course of this research work.

APPRECIATION

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