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Cocoa Powder Supplementation in Yoghurt Production

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Abstract: The use of cocoa powder as a nutritional supplement in yoghurt production was evaluated. The result showed that the final product has pleasant chocolate flavor and color and was acceptable. More importantly there was a marked increase in the protein and calorie level of the chocolate yoghurt. The product so produced was compared with locally existing commercialized yoghurt for its physico-chemical parameters like pH, total solids, specific gravity, titratable acidity, moisture, ash, protein and fat content. The results revealed that the formulated chocolate yoghurt has pH of 4.25, specific gravity of 1.0426 fat 3.64%, protein 6.82%, ash 0.88% and energy level of 225 cal $100g^{-1}$. The organoleptic appreciation revealed that preference was given to the newly developed yoghurt for its unique chocolate characteristics.

Key words: Supplementation, cocoa, milk, appraisal, chocolate flavor, yoghurt

INTRODUCTION

Yoghurt is a fermented milk product produced from imported powder milk by heating the milk to 90°C for 15-30 min, cooled to 43°C, inoculated with a 2% mixed culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* and held at this temperature for 3 h until the desired acidity of 0.85-0.95 acidity and pH of 4-4.5 is reached. The product is then cooled to 5°C for packaging.

Yoghurt has a typical flavor (sour taste) which is attributable to the production of lactic acids, acetaldehyde, acetic acid and diacetyl from carbohydrate by fermenting organisms.

Fermented milks are more nutritious and healthier than fresh milk (Mann, 1977; Kilara and Shahani, 1978). *Lactose malabsorber* often complain of gastric distress after consuming fresh unfermented milk or milk products (Hamilton *et al*., 1999). It is claimed that consumption of fermented milk results in a lower serum cholesterol level (Mann and Spoerry, 1974; Richardson, 1978; Grunewals, 1992; Palusani and Rao, 1983). It has also been shown that the *lactobacilli* which are the organisms responsible for the souring of such milk are useful for digestion as reported by Sandine (1972); Gervie (1984). Glass and Hendrik (1976) and Platt (1964) demonstrated that fermented milk products are very good source of the B-vitamins including cobalamine (B_{12}) and that initial amount may be increase during fermentative process. It has also been shown that lactose deficient patients tolerate fermented dairy products including yoghurt without symptoms of lactose intolerance (Jay, 1986; Gallagher *et al*., 1974).

Fermentation of milk results in the production of lactic acid which has the effect of lowering the pH and thereby arresting any further development of germs or other toxic microorganisms. It also has some lethal and destructive effect on bacteria and also arresting bacterial multiplication besides giving the final product the physiological characteristics.

Fermentation remains the form of transformation that is most practised in Africa. Fermented milk is even preferred to fresh milk because it has better storage stability and higher digestive ability (Sonogo, 1994).

Nutrition and health benefits for consuming yoghurt include an antibiotic effect and reduced incidence of lactose intolerance and gastro-intestinal illnesses (Labell, 1989; Kurmann *et al*., 1992).

Manufacturer have developed low fat and non-fat yoghurt products with improved compositional and nutritional properties but many variables affect consumers acceptability of such products. It exists as set or stirred (drinking) yoghurt; plain, partly skimmed or skimmed sweetened and flavored forms. Some yoghurt are flavored with discernible fruits, honey or essences (Kosikowski, 1982). The fruits and flowery essences can be used to create exciting new tastes and texture in yoghurt dessert (Hamilton, 1999).

Cocoa is a tree crop widely grown in Nigeria. Attempt to add value to this crop, its powder was incorporated into yoghurt production. This goes a long way inenhancing the nutritional status of the consumer.

Cocoa powder introduction into skimmed milk powder for yoghurt production will contribute to the reduction of monotony from the tables. Cocoa powder contains 22% protein, useful amount of vitamin A, riboflavin and

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nicotinic acid. It also contains minerals, iron and calcium. This will in no doubt be an added nutritional component to the newly formulated cocoa yoghurt.

MATERIALS AND METHODS

Skimmed milk powder was purchased at a popular supermarket in Ibadan, Nigeria and cocoa powder was obtained from the stock in Cocoa Research Institute of Nigeria (CRIN) Ibadan. Experimental yoghurt was prepared using the procedure of (Bille *et al*., 2004) with a slight modification (Fig. 1). Starter culture, lactose, sugar, flavor and other ingredients were purchased locally while processing pot, gas, stirrer, thermometer, water bath and refrigerator were made used of from the Crop Processing and Utilization unit of CRIN, Ibadan. Rural technology method of yoghurt making was followed as described by Bille *et al*. (2004).

About 18% skimmed milk was mixed with 2 L of water and 0.5% cocoa powder was added and mixed thoroughly. The mixture was pre-heated to 45°C and then filtered to remove extraneous materials. Lactose 5.5%, sucrose 3.5% and stabilizer were added mixed and sterilized at 78°C for 30 min. The fermentation vessel was prepared and filled with milk. This was allowed to cool to temperature of 45°C in a bath of cold water, 3% starter culture (*S. thermophilus* and *L. bulgaricus)* were added mixed and incubated for 7 h to coagulate. The yoghurt was finally cooled overnight in a bath of cold water <10°C. The product was packaged in plastic cups with cover for further analysis.

Chemical analysis: pH measurement was made with a standardized pH meter (pH meter kent EK 7020). Titrable Acidity (TA, lactic acid %) was determined by titration of sample against 0.1 N NaoH (Speck, 1984). The AOAC (1980) and Pearson (1976) methods determined moisture, crude fat, protein and total ash content. The refractometric method described by Akinsonya (1998) was used to determine the sugar content of the yoghurt as follows: 20 mL of yoghurt was mixed with 10 mL of 10% lead acetate in a beaker and filtered through Whatman's filter paper No. 4 into 100 mL volumetric flask. Two spoonful of sodium hydrogen carbonate was added to the filtrate to precipitate excess lead and then filtered. The filterate was used for the refractometric determination of the sugar content using Abbe 60 Refractometer. The viscosity was measured using viscometer.

Sensory evaluation: A 9-point hedonic scale was used to measure the sensory qualities i.e., colour, aroma, mouth feel/texture, taste and overall acceptability of the product (Larmand, 1977). Ten member in-trained panelists that are used to yoghurt taste were used to ascertain/detect any differences between the chocolate yoghurt and the locally purchased commercialized products. These samples were coded differently and served to the panelists with a glass of water to rinse their mouth in between the tasting period. The scale of preference ranges from 9 representing like extremely to 1 representing dislike extremely.

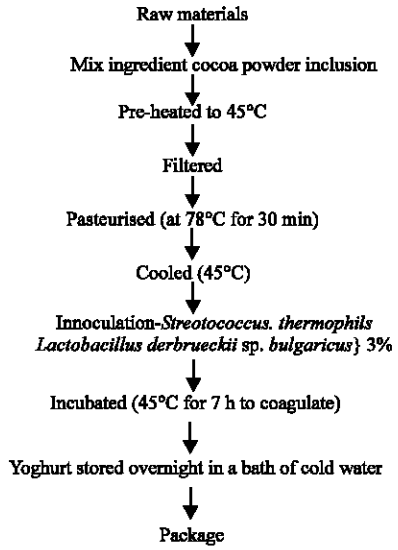

Fig. 1: Processing steps for experimental yogurt

Statistical analysis: The results obtained were subjected to Analysis of Variance (ANOVA). Mean comparisons were carried out between the two yoghurt samples by Turkeys Multiple Range Test and by Statistical Programs for Social Sciences.

RESULTS AND DISCUSSION

The chemical compositions of chocolate yoghurt and the commercially sold ones are shown in Table 1. The lower pH of 4.10 and 4.30 for commercialized yoghurt and chocolate yoghurt, respectively as observed in this study was a reflection of the souring activity of lactics and thus could be explained in high Titratable Acidity (TA) 0.5-0.6. Reed noted in his research that good quality yoghurt should have pH of 4.15 and TA (lactic acid percent) of 0.5.

The values obtained in this study are similar to these stated values. The crude ash content of commercial samples 0.76% is lower than that of chocolate yoghurt (0.88%). Crude protein (%) results showed that chocolate yoghurt of 6.82 was higher than the commercial yoghurt 4.18.

The inclusion of cocoa powder improves the crude protein value substantially. These starter cultures in addition to fermentation are able to produce essential

Table 1: Proximate composition of yoghurt

Analysis	Yoghurt commercial	Chocolate yoghurt
pH	4.1000	4.2500
TA (%)	0.5000	0.6000
Moisture content (%)	69.0000	65.4200
Crude protein (%)	16.7200	24.8800
Crude fat (%)	36.0900	43.3800
Total soluble solids	59.2000	62.8000
Ash (%)	0.7600	0.8800
Specific gravity	1.0212	1.0426
Viscosity (sec.)	205.7000	202.2000
Caloric value (KJ)	112.0100	133.0600
Dry matter (%)	14.4700	16.0200

amino acids from the added cocoa powder owing to their proteolytic nature, hence increase in the protein content observed with chocolate yoghurt. Similarly the crude fat content (%) ranges from 3.01 of commercialized yoghurt to 3.64 of chocolate yoghurt. Egan *et al*. (1981) and Terna and Musa (1998) stated in their study that commercial yoghurt should have the following minimum proximate compositions which are 3.5% for protein, 3.25% fat and 87.7% moisture. This result conformed to the recommended values obtained by these researches.

The coagulation time of the chocolate yoghurt sample was 7 h. It has been reported that the duration of fermentation at 40-45°C takes 3-6 h (Ebing and Rutgers, 1996) and 3-5 h at 45°C (Kosikowski 1982). The fermentation time for this experiment (7 h) was extended due to the inclusion of cocoa powder that resulted to the increase in fermentation time. Lactose is the fermentable sugar generally preferred by lactic acid bacteria that is why lactose was added to composite milk prior to fermentation in order to enhance the souring ability of the lactics.

Milk pasteurization (75°C) was done to modify milk protein so as to enhance proper viscosity and gelatinization of the product. This is in agreement with the research of Reed. This also resulted into uniformity and smoothness in body texture of the yoghurt samples as shown in Table 1. The viscosity of the commercial yoghurt was more pronounced. The inclusion of cocoa powder invariably affected the viscosity of the chocolate samples. The organoleptic appraisals of the yoghurt samples were shown in Table 2.

The flavor of chocolate samples was more acceptable in that it combines fermented and chocolate flavor together. The product has chocolate colour with semi-solid texture. The taste was slightly sour. The overall acceptability showed that chocolate yoghurt sample was more acceptable but does not show any significant difference at ($p<0.05$). Though, there was a significant difference at ($p>0.05$) for colour and aroma. The caloric

Table 2: Mean comparison of sensory evaluation scores of chocolate yoghurt and locally commercialized yoghurt

Yoghurt	Aroma	Colour	Taste	Texture	Overall acceptability
Chocolate yoghurt	8.0^a	6.7NS	7.4NS	7.8NS	8.0NS
Commercial yoghurt 1	6.8^b	7.0	7.4	8.0	7.8
Commercial yoghurt 2	6.3^b	7.0	7.0	7.5	8.0
Commercial yoghurt 3	6.0^b	6.6	6.9	7.8	7.5

Letters with the same column are significantly different ($p<0.05$); NS-Not significant

Table 3: Mean values of bacteriological analyses of chocolate yoghurt and commercialized yoghurt

Identity	Test	Result
Chocolate yoghurt	Total count (37°C)	1×10^6 Cfu g^{-*1}
	E. coli/coliforms	Nil
	Staphylococcus aureus	Nil
	Salmonella sp.	Nil
	Clostridium sp.	Nil
Commercialized yoghurt	Total count	1×10^6 cfu g^{-1}
	E. coli	Nil
	Staphylococcus aureus	Nil
	Salmonella sp.	Nil
	Clostridium sp.	Nil

*Cfu g^{-1} Colony forming unit per gram

value was calculated by multiplying carbohydrate ×4, fat ×9 and protein by 4. From the result the calorific value of the chocolate yoghurt (133.06 KJ) was higher than that of the commercial yoghurt (112.01 KJ). This means that chocolate yoghurt can be taken as proteinous and energy food. The bacteriological quality of chocolate yoghurt samples and that of the commercial yoghurt samples as shown in Table 3 reveals that total count of the samples is 1×10^6 cfu g^{-1} while specific count *Escherichia coli*, *Streptococcus aureus*, *salmonella* sp. and *clostridium* sp. were negative for both samples.

It could be deduced that the total counts observed on the Table 3 were as a result of the cultures used to ferment the yoghurt, thereby resulting in the production of lactic acid which are lethal to some organisms. Lactic acid bacteria also produce hydrogen peroxide, diacetyl and bacteriosis as antimicrobial substances which create hostile environment for food-borne pathogen and spoilage organisms and therefore able to suppress the multiplication of pathogenic and putrefying bacteria.

We believed that pasteurization temperature of (75°C for 30 min) would have effectively destroyed any microbes present in the milk samples coupled with the low pH values. Also the traditional starter cultures used in chocolate-yoghurt production contain substantial quantities of B-D-galactosidase enzyme and consumption of chocolate yoghurt may assist in alleviating the symptoms of lactose maladsorption. The chocolate yoghurt was thus considered to be safemicro biologically.

CONCLUSION

This research indicates that it is possible to produce good quality yoghurt that is well acceptable for human consumption using non-fat milk powder and cocoa powder. It was also observed that chocolate yoghurt combined the characteristics of chocolate drink and yoghurt together, this makes the product more enjoyable and pleasurable. Thus chocolate yoghurt due to its content and viscocity can delay gastric emptying and will be of an immense benefit for lactose intolerance people since the lactose would have been converted to lactic acid during fermentation.

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