PHYSICO-CHEMICAL PROPERTIES OF 'WARA' CHEESE PRECIPITATED WITH SODOM APPLE AND PAWPAW LEAF JUICE

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ABSTRACT
A study was conducted to access the physicochemical properties of 'wara' cheese precipitated with sodom apple or pawpaw leaf juice. These coagulants were applied to fresh Zebu milk or reconstituted milk powder at 50°C and heated slowly until boiling point was reached. Chemical composition of both milk showed that fresh Zebu milk had higher fat, lactose and total solids than reconstituted milk powder. Crude protein content of cheese coagulated with Sodom apple was lower than those coagulated with pawpaw leaf juice. However, cheese precipitated with sodom apple required a higher volume (10ml) of juice per litre of milk than cheese precipitated with pawpaw leaf (8ml) juice. Organoleptic assessment also revealed that cheese precipitated with sodom apple were preferred to cheese precipitated with pawpaw leaf extract. The higher protein content and preference of consumers for sodom apple-precipitated cheese, probably explain why this coagulant is preferred among local cheese makers.

INTRODUCTION
Milk is a highly nutritious product and is high in protein, calcium, phosphorus, and riboflavin. However, it is also a perishable product. It is an important product in the pastoral and agro-pastoral system of northern Nigeria as well as the small holder peri-urban systems of humid southern Nigeria (Bankole and Okagbue, 1996). In these systems, milk is consumed either fresh or processed into other products which are sold in nearly all markets.
Cheese is a high protein product made by coagulating casein in milk. It is produced in almost every country of the world with more than 2000 varieties in existence. Cheese can be classified based on its level of ripening, moisture or fat content, hence these are ripened or unripened cheese, high or low fat cheese, and soft or hard cheese. 'Wara' is a soft, unripened cheese and serves as a means of concentrating valuable nutrients in milk and extending shelf-life of milk by about 12 hours. It is an excellent source of protein, fat and minerals such as calcium, phosphorus, vitamins and essential amino acids and therefore it is an important food in the diet of both young and old people (Adegoke *et al.*, 1992).

MATERIAL AND METHODS
Fresh milk collected from a White Fulani herd was used for the study. Reconstituted milk was prepared by adding four litres of water to 500g of powdered milk and mixed thoroughly.
10mls of extracted sodom apple (*Calotropis procera*) juice was added to 1litre of warmed (50°C) milk which was then heated and stirred over a slow-burning fire until there was a visible separation of curds and whey. Cooking continued for 3 – 5 minutes at 80°C – 82°C to release the whey and inactivate enzymes in the juice. Whey was then separated from the cheese using the cheese cloth and the cheese was left to drain for about one hour, placing a weight of 2.5kg. The cheese was cut and pressed into 200ml plastic containers with cover.
Same procedure described above was followed for cheese formed with pawpaw leaf juice except that 8mls of pawpaw leaf juice was added.
Volume and weight of cheese obtained were recorded and samples were taken from each of the cheese produced and also from purchased cheese (control) for determination of moisture content, total solids, crude protein, lactose, ash content as described by O'Mahony (1988). Fat content was determined by Gerber's method. Ash was determined using the method described by (AOAC, 2000). The physical properties of cheese were investigated in a 9-point hedonic scale, (Stone and Sidel, 1985), using a 10-man taste panel. Labeled samples were presented before the panelists and each panelist was given a glass of water to rinse their mouth after each sample has been tasted and observed.
All data were subjected to ANOVA using SAS (2000).

RESULTS AND DISCUSSION
The results from the Table 1 showed that there was no significant difference ($P>0.05$) in pH of the samples and all samples tended to be 7 pH. This was expected since no observable fermentation occurred in any of the samples.

Table 1: The chemical composition of cheese produced from fresh and reconstituted milk powder using Sodom apple and paw-paw leaf extract

Parameters	Fresh milk	Reconstituted milk	FMSA	RMSA	FMPL	RMPL	PC (control)
Moisture	86.19	88.60	47.50^{c}	50.00^{b}	53.57^{a}	52.60^{a}	47.9^{c}
Fat	4.10	2.70	32.40^{ab}	31.80^{b}	31.20^{b}	30.60^{c}	33.10^{a}
Crude protein	3.57	3.20	27.60^{c}	26.70^{d}	28.60^{b}	29.70^{a}	24.60^{e}
Lactose	5.57	4.70	4.70^{b}	4.90^{b}	3.85^{c}	4.07^{d}	5.60^{a}
Ash	0.57	0.80	4.80^{b}	5.60^{a}	5.20^{a}	4.97^{b}	3.90^{c}
pH	6.55	7.13	7.12^{a}	7.08^{a}	7.03^{a}	7.08^{a}	7.42^{a}

a,b,c,d means with the same superscript on the same row are not significantly (P> 0.05) different.
FMSA – Fresh milk with Sodom apple
RMSA – Reconstituted milk milk Sodom apple
FMPL- Fresh milk with pawpaw leaf juice
RMPL- Reconstituted milk with pawpaw leaf juice
PC – Purchased cheese (control)

The moisture content of cheese was higher in FMPL and RMPL. However, there were no significant differences ($p>0.05$) between FMSA and control. This result could be due to stronger coagulating strength of the sodom apple extract. The observation in this study agrees with the report of Adetunji and Salawu (2008) that the moisture content of Sodom apple-processed cheese was higher than that of pawpaw leaf cheese. Adegoke *et al.* (1992) reported that higher moisture content could favour growth and proliferation of micro organism, thus reducing the shelf life of cheese.

The lactose content of cheese obtained in this study was higher than 3.2% obtained by Onatola (2004) but lower than that of control (5.0%). Adetunji and Salawu (2008) however, indicated that sodom apple cheese had higher lactose content and was 74.69% higher than pawpaw-processed cheese. There was little variation in fat content of FMSA, RMSA, FMPL and control. However, fat content of RMPL was significantly ($p<0.05$) lower. The fat content obtained in this work was higher than the values obtained by Alalade and Adeneye (2006).

Crude protein content of cheese coagulated with pawpaw leaf juice was higher than those coagulated with Sodom apple. This findings is contrary to the report of Adetunji and Salawu, 2008 (31.60% and 33.84%) for processed cheese using pawpaw leaf and sodom apple juice respectively. It is possible that pawpaw leaf juice has greater ability to precipitate casein from milk than sodom apple. This however needs to be verified in subsequent investigations.

Table 2 shows the percentage preference of panelists for the various cheeses based on their perception of the aroma, taste, colour, texture and overall acceptability. The result showed that purchased cheese had the highest preference among panelists, followed by reconstituted milk with sodom apple juice while reconstituted milk with pawpaw leaf juice was least preferred. On the average, cheese precipitated with sodom apple was better accepted than cheese precipitated with pawpaw leaf juice.

CONCLUSION

Crude protein content of cheese coagulated with sodom apple was lower than those coagulated with pawpaw leaf juice while organoleptic assessment revealed that cheese precipitated with sodom apple were preferred to cheese precipitated with pawpaw leaf extract. There is need to further investigate ways of improving acceptance of cheese precipitated with extracts from pawpaw leaf in order to increase the baseline of plant rennets used for cheese-making in Nigeria.

Table 2: Percentage preference for soft cheese ("wara") precipitated by sodom apple or pawpaw leaf extract

Sensory qualities	FMSA	RMSA	FMPL	RMPL	PC (control)
Taste	16	13	21	25	25
Colour	20	17	14	9	40
Aroma	17	19	21	23	20
Texture	18	20	23	14	25
Overall acceptability	17	22	19	17	25

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