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COMPARATIVE EVALUATION OF SODOM APPLE EXTRACT AND LEMON JUICE AS VEGETABLE COAGULANTS IN THE MANUFACTURE OF HOME MADE CHEESE

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ABSTRACT

An experiment was carried out to compare the quality characteristics of cheese produced using Sodom apple and Lemon juice as plant coagulants. The weight of cheese produced from 1000ml of milk with 100ml of Sodom apple extract was 215.5g while 134.4g of cheese was obtained when Lemon juice was used. The volume of whey obtained using Sodom apple extract was 864.6ml while Lemon juice produced 939.3ml of whey. The average pH of Sodom apple cheese was 6.36 while that of lemon juice cheese produced using Lemon juice was 5.16. Proximate analysis revealed that Sodom apple cheese had crude protein content of 22.00% significantly ($p<0.05$) lower than Lemon juice cheese of 29.33%. Ether extract content for Sodom apple cheese was 19.00% while that of Lemon juice was 28.67%. The ash content of the cheese was 9.67% while 7.67% for Sodom apple and Lemon juice cheese respectively. The moisture content for Sodom apple cheese was 60.00% while that of Lemon juice was 46.67%. The mineral analysis revealed that cheese produced from Lemon juice was higher in sodium, potassium, phosphorus and selenium compared to cheese produced from Sodom apple. Cheese produced from Sodom apple extract had higher refrigeration weight loss of 2.80%. It can be concluded that cheese produced from Lemon juice was superior in nutrient content: sodium, potassium, phosphorus and selenium and storage stability compared to the cheese obtained from Sodom apple extract.

Keywords: Cheese, Sodom apple extract, Lemon juice, Vegetable Coagulants.

INTRODUCTION

Cheese is an important dairy product and an integral part of a healthful diet due to its substantial contribution to human health. It is an excellent source of protein, fat and minerals such as calcium, iron and phosphorus, vitamins and essential amino acids and therefore its an important food in the diet of both young and old people (O'Connor, 1993). It is especially good for the bone of children, elderly people, and pregnant lactating women for strengthening bone and cartilage (O'Connor, 1993). Cheese is a rich source of bioactive peptides which have a positive influence on hypertension, although their effect is less pronounced than what has been observed with drugs based on the same principle (Li, 2007).

Cheese is made in almost every country of

the world and there exists more than 2000 varieties. Despite the large number of varieties, cheese may be classified into different groups, i.e ripened and unripened cheese, cheese with low or high fat content and cheese with soft or hard consistency. The basic reason for purposely processing milk into cheese is to preserve a perishable food and to convert it into a stable and storable product. It also expands the variety of food (Vedamuthu and Washam, 1983). Unprocessed milk held at high ambient temperatures has a shelf life from 2-3 hours up to 24hours. Cheese, however, has a shelf life from 4-5 days up to five years depending on the variety (Vedamuthu and Washam, 1983). Production of cheese is dynamic on the time, temperature, the bacterial culture (lactic acid bacteria) and coagulating enzyme that are used to concentrate and separate the casein (milk protein) and fat from the whey (Fox *et al.* 2000).

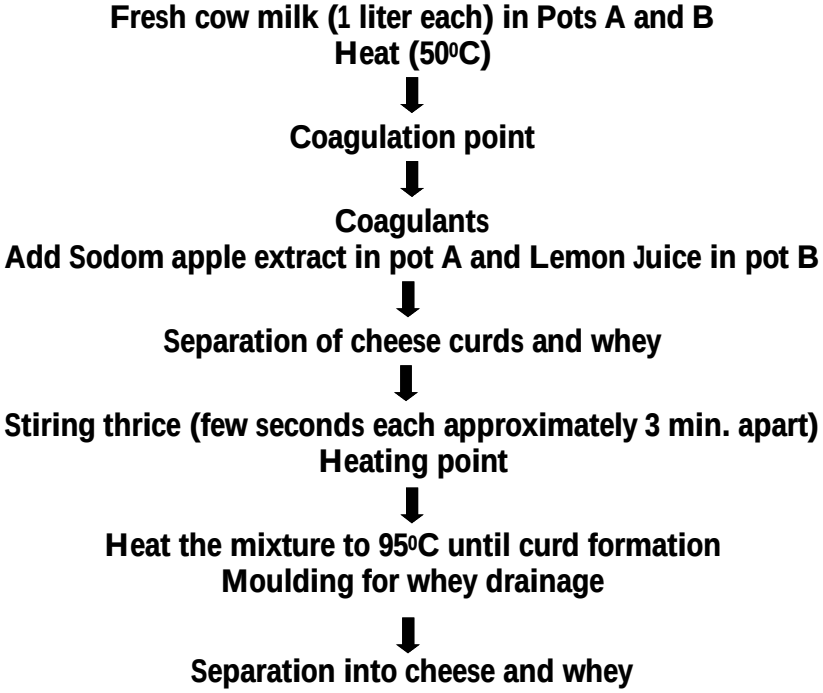
The most important coagulant used in the production of cheese in Nigeria is obtained from *Calotropis procera* (Sodom apple). The lemons are a type of berry called hesperidium. They grow in sub-tropical and tropical; areas (Morton, 1987). There is need to know the potentials of other coagulant such as *Citrus limon* (Lemon juice) in the manufacture of home-made cheese Therefore, the aim of this study was to determine quality of home-made cheese produced from cattle milk using two types of plant coagulants (Sodom apple extract and Lemon juice).

MATERIALS AND METHODS

The experiment was carried out in the Animal Product Processing Laboratory, Department of Animal Production and Health, Federal University of Agriculture, Abeokuta, Nigeria which falls within the rainforest region with a typical hot and humid climate. The region is 76 m above sea level, lies at latitude 7°13 49.4''N and longitude 3°26 11.98''E. The climate is humid with mean annual precipitation, temperature and relative humidity of 1,112.11 mm, 34°C and 80% respectively.

EXPERIMENTAL PROCEDURE

Sodom apple and Lemon were obtained from Kotopo and Kuto, Nigeria, Ogun State. Fresh milk was collected from White Fulani cattle obtained from the cattle unit of Directorate of University Farms, Federal University of Agriculture, Abeokuta, Nigeria. Fresh milk sample (1 litre) was collected from White Fulani breed of cattle. The milk was taken to the laboratory where the pH was determined using a digital Ph meter, uk 3015 Dunmiu Essex England. The weight was taken after 24 hours to determine any refrigeration weight loss. Each portion of cow milk was boiled over an electric cooker. Fresh Sodom apple was prepared by crushing 60g of the leaves and the extract added to warm milk for 5 minutes to allow the enzymes in the leaves to react with the milk. Fresh Lemon fruits were squeezed very carefully to avoid any contamination and screened through a 8.5mm sieve to obtain the juice. One litre of milk was poured into each pot (A and B).The milk in the pot was heated to approximately 50°C in about 30-40min. The extract of Sodom apple and Lemon juice (100ml each) was then added separately to the heated milk and stirred intermittently until boiling point and coagulation (curd formation:visible separation into cheese and whey). The loose curds were poured into 8.5mm sieve to facilitate whey drainage and also to mold into shape. The flow chart for the recipe is shown in figure 1 below.



Proximate analysis such as crude protein, ether extract, ash and moisture were also carried out on the cheese samples according to AOAC. (2000). The mineral contents (phosphorus, magnesium, sodium, potassium and selenium) of the cheese produced were also determined. Atomic absorption spectrophotometer was used to determine the mineral elements content in the Central Laboratory of the Biotechnology of FUNAAB. Means were analyzed using the student T-test at 5% significant level SAS (1999).

RESULTS AND DISCUSSION

Yield of Cheese obtained

Sodom apple cheese had a weight of 215.5g while lemon cheese was 134.4g as presented in Table 1. The higher values of cheese weight whe compared with cheese weight obtained from Lemon juice could be due to different chemical composition of the plant coagulants used. This result agrees with the report of Akinloye and Adewumi, (2014).

Table 1: Yield and pH of cheese produced with Sodom apple extract and Lemon juice

Parameters	Cheese	
	Sodom apple extract	Lemon juice
Weight of cheese (g)	215.5	134.4
Volume of whey (ml)	864.6	939.3
pH of whey	6.26	4.02
pH of cheese	6.36	5.16

Volume of whey obtained

Volume of whey obtained from Sodom apple cheese was 864.6ml while that of lemon cheese was 939.3ml. The difference could be due to effect of citric acid of the Lemon juice on casein of milk which caused smaller part of the milk to shrink thereby yielding a lot of whey. On the contrary, the proteolytic enzyme in Sodom apple probably caused most of the milk to curdle thereby producing less whey.

pH of Cheese

The pH of Sodom apple cheese was 6.36, while that of lemon cheese was 5.16. The difference could be due to the citric acid in lemon which made the cheese to be acidic, while the proteolytic enzyme in Sodom apple made the cheese to be alkaline. The pH of Sodom apple cheese recorded in this study is higher than the value reported by Vaboi-Egbeni (2010) who introduced starter culture and fermented the cheese while Adetunji and Babalobi (2011) inoculated the cheese with bacteria.

Proximate composition of Cheese

The moisture content of Sodom apple cheese (60.00%) was higher than for cheese processed with Lemon juice cheese of 46.67%. The higher moisture content from Sodom apple could be attributed to the coagulating material. Although, this result is in contrast with the result of Omotosho *et al* (2011) who reported 51% moisture content in cheese produced from Sodom apple, it is, however, similar to the result of Adegoke *et al.* (1992) who reported 61.70% moisture content in cheese produced from Sodom apple. Variation in moisture content of cheese could be attributed to the coagulating strength of the leaves of the plant which may be obtained under different methods and environment. It must be noted that higher moisture content is not preferred because it could favour the growth and proliferation of micro-organisms that reduces the shelf life of cheese (Adegoke *et al,* 1992). This is similar to the findings of Akinloye and Adewumi (2014) who reported that Lemon juice had been found to have the strongest coagulating ability when compared to Sodom apple and *Carica papaya* extract. The crude protein content of Sodom apple cheese (22.00%) was lower than that of Lemon juice of 29.33% (Table 2). The protein obtained from this study was higher than the value recorded by Adetunji and Babalobi (2011) who reported 20.78% for cheese produced using Sodom apple. This could be due to the higher dry matter content of the cheese obtained from Lemon juice. However, the result is comparable to that of Omotosho *et al.,* (2011), Adetunji and Salawu (2008) who reported values of 25.56% and 33.84% respectively. Sodom apple cheese had a lower crude fat of 19.00% than that of Lemon juice (28.67%). The fat in Sodom apple cheese is within the range of 11.2% - 21.9% as reported by Ogundiwin and Oke (1982) and similar to that of Uzeh *et al* (2006) who reported 18.55%. The percentage ash in Sodom apple cheese was 9.67% while that of Lemon juice cheese was 7.67%.

Table 2: Proximate composition (%) of homemade cheese produced using from Sodom apple extract and Lemon juice

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Parameters (%)	Cheese	
	Sodom apple extract	Lemon juice
Crude protein	22.00±2.65b	29.33±0.58a
Ether extract	19.00±2.00	28.67±1.15
Ash	9.67±2.89	7.67±2.52
Moisture	60.00±2.00	46.67±1.53

[a,b] means in the same row with different superscripts are significantly different ($p<0.05$)

Mineral composition of Cheese

Mineral composition of Cheese from Sodom apple and Lemon juice was statistically similar ($p<0.05$). The Sodium content of Sodom apple cheese was 0.11% while lemon cheese had a value of 0.19%. Omotosho *et al* (2011) reported the sodium content in apple cheese to be 16.98% while Adetunji and Babalobi (2011) reported the sodium content of Sodom apple cheese to be 0.24%, while lemon cheese apple had a value of 0.19%. Omotosho *et al,* (2011) reported Potassium content of Sodom apple to be 22.5% while Adetunji and Babalobi (2011) reported the Potassium content of Sodom apple to be 0.16% (Table 3). Calcium content of Sodom apple was 0.27% while lemon cheese had a value of 0.41%. The calcium content obtained in this work was higher than the value reported by Omotosho *et al*. (2011) and Adetunji and Babalobi (2011). Conversely, Adewumi and Akinloye, 2016 observed a lower calcium in cheese obtained from Sodom apple. This may be due to the low protein content in milk. Adewumi *et al*. (2016). Adetunji and Babalobi (2011) reported 0.71% phosphorus content of Sodom apple while lemon cheese had a value of 0.93%. Selenium content of Sodom apple was 2.52%, while lemon cheese had a value of 3.50%.

Table 3: Mineral composition of cheese produced from Sodom apple extract and Lemon juice

Parameters (%)	**Cheese**	
	Sodom apple extract	**Lemon juice**
Sodium	0.11±0.02	0.19±0.02
Potassium	0.24±0.01	0.34±0.01
Calcium	0.27±0.00	0.17±0.19
Phosphorus	0.71±0.00	0.93±0.01
Selenium	2.52±0.00	3.50±0.21

Means in the same row are not significantly different

Storage stability of Cheese

The weight loss of cheese produced with Lemon juice was 0.98% after 24hours of storage while the Sodom apple had weight loss of 2.80% (Table 4). The result obtained from the Sodom apple cheese does not support the finding of Yunusa (2011) who reported that the cheese produced using Sodom apple was stable upon refrigeration after 24 hours.

Table 4: Storage stability of home -made cheese produced from Sodom apple extract and Lemon juice

Parameters	Cheese	
	Sodom apple extract	Lemon juice
Initial weight (g)	15.33±5.29	9.40±2.52
Final weight (g)	14.93±5.19	9.03±2.44
Weight loss (g)	0.43±0.15	0.10±0.10
Weight loss (%)	2.80±0.00a	0.98±0.86b

a, b mean in the same row with different superscripts are significantly different (p>0.05)

CONCLUSION

Cheese obtained using Lemon juice had higher crude protein content. However, since there was no significant difference in the yield of both cheeses, it could be concluded that Lemon juice and Sodom apple juice can be used as plant coagulants in the production of home-made cheese without adverse effect on the quantity.

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