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Effect of Some Selected Coagulants on the Proximate and Microbiological Quality of Cheese Produced from Soy Milk

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Abstract: ***This research highlight the production of cheese from soymilk using five different types of coagulants (soursop, passion fruit, baobab pulp, pineapple and tamarind pulp) were used to assess the effect of these coagulants on the proximate, microbiological, antioxidants and sensory properties of soycheese. The proximate results, the protein, moisture, crude fat, ash, fibre and carbohydrates ranged from 13.93-16.78 %, 38.88-42.92 %, 20.22-23.34 %, 1.31-1.74 %, 4.34-5.64 % and 12.72-17.10 % respectively. The total viable counts ranged from 1.1×10^{1}-1.2×10^{2} Cfu/ml and 2.9×10^{2}-6.6×10^{2} Cfu/ml in their total viable counts and fungi counts respectively. The results of the antioxidants indicated that the baobab coagulated soycheese was significantly different ($p<0.05$) from other soycheese in their DPPH, FRAP, ABTS and ORAC values. The result obtained from sensory evaluation showed that the soycheese coagulated with different coagulants showed no significant ($p<0.05$) different in their taste and textural properties. The products are highly generally accepted but the soursop (8.25%) coagulated soycheese was the most generally accepted product and the least was the passion fruit (7.30%) coagulated soycheese.***

Keywords: antioxidant, coagulants, tamarin, microbiological and proximate

1. Introduction

Cheese has been defined as a product made from the curd obtained from milk by coagulating the casein with the help of rennet or similar enzymes in the presence of lactic acid produced by added microorganisms, from which part of the moisture has been removed by cutting, cooking and/or pressing, which has been shaped in a mould, and then ripened by holding it for some time at suitable temperature and humidity (Adetunji et al., 2008). The essential ingredients of cheese are milk, coagulants (coagulants cause liquid to thicken or transforms liquid into a soft semi-solid mass), bacterial cultures and salt. The coagulant causes the milk protein to aggregate and ultimately transform fluid milk to a semi-firm gel. When this gel is cut into small pieces (curds), the whey (mostly water and lactose) begins to separate from the curds. Cheese is a concentrated source of many of the nutrients in milk. The use of vegetable extracts as milk coagulants in soft cheese processing has been known traditionally in some parts of West Africa like Nigeria and the Republic of Benin (Agustine et al., 2014).

Soymilk, a dairy milk substitute easily prepared from mature dry beans is fast becoming a household food in developing countries including Nigeria because of its diet improving capabilities (Obiegbuna *et al.*, 2014). Like animal milk, soymilk is used in the manufacture of other food products due to its functional properties and nutritive value. Despite its intrinsic beany flavor, it has gained wild acceptances. However, utilization is limited due to short shelf-life. Local processors of soymilk in Nigeria, rather than discarding the unsold milk at the end of the day due to lack of refrigeration facilities, coagulate it into curd using lime juice. This coagulated product known as tofu, has found acceptances as a high protein food for human consumption and has been used as a protein source in the orient for many centuries. Tofu or soybean curd is most important and valued soy food throughout the world especially in Eastern and South Eastern Asian countries due to their inexpensive and high quality protein (Birthal *et al*., 2010). It is cholesterol free and contains high quality protein that can be easily digested (Guan, 2009).

Traditionally, in the northern part of Nigeria, it is produced by curdling fresh hot soymilk either with $CaCl_2$, $MgSO_4$, Alum or steep water (effluence from pap produced from maize) (Yakubu and Amuzat, 2012).

Coagulation is the most important step in soybean curd making process (Jianming *et al.*, 2013). Various coagulants used in curdling or coagulating soymilk have been listed. The most commonly used coagulants are calcium and magnesium salts and glucono-δ-lactone depending on tofu type (Panyathitipong and Puechkamut, 2008). Usually, $CaSO_4$ and glucono-δ-lactone are used more than other coagulants on the industrial scale for tofu making (Obiegbuna *et al.*, 2014). Factors such as variety of soybean (Sarani *et al.*, 2014), processing method and type and concentration of coagulant (Sarani *et al.*, 2014), have been reported to influence the yield, quality and texture of tofu. It has been demonstrated that the rheological properties of winged bean and pea curds; and soybean curd were affected by the coagulant used in their preparations. Soybean varieties influenced the qualities of soymilk and also affected the functional properties of tofu powder (Panyathitipong and Puechkamut 2008). It has also been reported Shokunbi *et al.*, (2011) that coagulants influence the yield and micronutrients contents of tofu. The effects of the coagulants on the functional properties of soybean curds have not or have rarely been investigated. The most common coagulant available to the local processor in Nigeria is lime juice (Obiegbuna *et al*., 2014).

The objective of the study is to evaluate the effect of coagulants on the proximate and microbiological quality of cheese produced from soymilk.

2. Materials and Methods

2.1 Source of Materials and Preparation

The soybean (*Glycine max*) was purchased from Northbank Market, Makurdi Benue State. Fruits (soursop, passion fruit, baobab, pineapple and tamarind) were purchased from fruit market, Makurdi Benue State and were taken to the Department of Food Science and Technology, Federal University of Agriculture Makurdi. The raw materials were properly cleaned by removing extraneous matter prior to their subjection to different processing treatments.

2.2 Processing Methods

2.2.1 Preparation of coagulants

Soursop (*Annona muricata)*, passion fruit (*Passiflora edulis*), baobab (*Adansonia digitata*), pineapple (Ananas comosus) and tamarind (*Tamarindus indica L.*) coagulants were prepared as shown below.

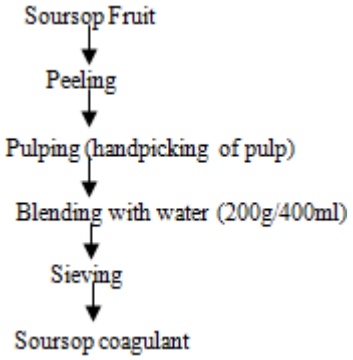

Figure 1: Flow Chart Showing the Production of Soursop Coagulant
Source: (Omotosho *et al*., 2011).

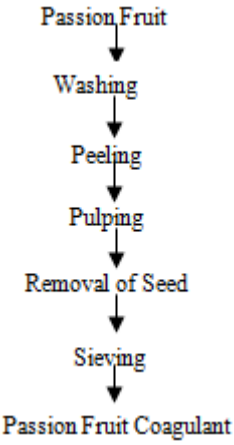

Figure 2: Flow chart for the production of passion fruit coagulant.
Source: (Omotosho *et al*., 2011 with modification)

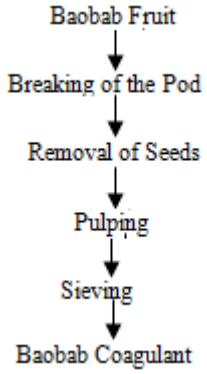

Figure 3: Flow chart for the production of baobab coagulant.
Source: (Augustine *et al*., 2014 with modification)

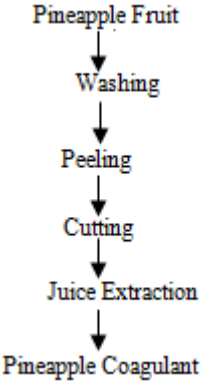

Figure 4: Flow chart for the production of pineapple coagulant
Source: (Augustine *et al*., 2014 with modification).

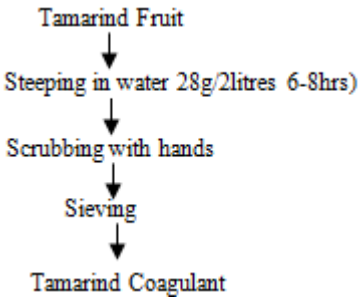

Figure 5: Flow chart for the production of tamarind coagulant.
Source: (Augustine et al., 2014 with modification).

2.3 Preparation of Soy Cheese

Soy cheese was prepared according to the method of Oboh and Omotosho (2012) based on formulation on Table 1. Soybeans were washed, soaked in water for 6hrs, drained, milled and sieved after which lactose (15% w/v) was added. The soymilk was heated to about 110^0C for about 5 minutes with constant stirring. Coagulant solutions (30 ml of soursop, passion fruit, baobab, pineapple and tamarind) were added in 3000 ml of soymilk each and were allowed to solidify forming curds. The curds were removed from heat and further compressed to remove whey to make firm curds, which were then cut into desirable shapes and fried.

Table 1: Formulation for Soycheese and Coagulants

Sample	Coagulant Quantity (ml)	Soymilk Quantity (ml)
A	30	3000
B	30	3000
C	30	3000
D	30	3000
E	30	3000

Key A= Soursop Coagulated Soycheese, B= Passion Fruit Coagulated Soycheese, C= Baobab Coagulated Soycheese, D= Pineapple coagulated Soycheese, E= Tamarind Coagulated soycheese

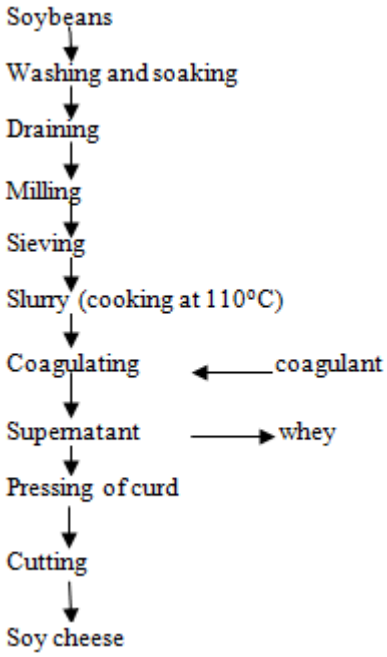

Figure 6: flow chart showing the production of soycheese
Source: (Oboh and Omotosho 2012)

2.4 Determination of the Proximate Composition of Soycheese

2.4.1 Moisture Content Determination

Moisture content was determined using the air oven dry method (AOAC, 2012). A clean dish with a lid was dried in an oven (GENLAB, England B6S, serial no: 85K054) at 100°C for 30min. It was cooled in desiccators and weighed. Two (2) grams of sample was then weighed into the dish. The dish with its content was then put in the oven at 105°C and dried to a fairly constant weight. The loss in weight from the original sample (before heating) was reported as percentage moisture.

$$\% \, Moisture = \frac{weight\ loss\ (W2-W3)}{Weight\ of\ Sample\ (W2-W1)} \ x\ 100 \ldots\ldots (1)$$

Where: W_1 = weight of dish, W_2 = weight of dish + sample before drying, W_3 = weight of dish + sample after drying.

2.4.2 Crude Protein Determination

The Kjeldahl method as described by AOAC (2012) was used to determine the percentage crude protein. Two (2) grams of sample was weighed into a Kjeldahl digestion flask using a digital weighing balance (3000g x 0.01g 6.6LB). A catalyst mixture weighing 0.88g (96% anhydrous sodium sulphate, 3.5% copper sulphate and 0.5% selenium dioxide) was added. Concentrated sulphuric acid (7ml) was added and swirled to mix content. The Kjeldahl flask was heated gently in an inclined position in the fume chamber until no particles of the sample was adhered to the side of flask. The solution was heated more strongly to make the liquid boil with intermittent shaking of the flask until clear solution was obtained. The solution was allowed to cool and diluted to 25ml with distilled water in a volumetric flask. Ten (10) ml of diluted digest was transferred into a steam distillation apparatus. The digest was made alkaline with 8ml of 40% NaOH. To the receiving flask, 5ml of 2% boric acid solution was added and 3 drops of mixed indicator was dropped. The distillation apparatus was connected to the receiving flask with the delivery tube dipped into the 100ml conical flask and titrated with 0.01 HCl. A blank titration was done. The percentage nitrogen was calculated from the formula:

$$\% \, Nitrogen = \frac{(S-B)\times 0.0014 \times 100 \times D}{sample\ weight} \ldots\ldots\ldots\ldots (2)$$

Where, S = sample titre, B = Blank titre, S - B = Corrected titre, D = Diluted factor
% Crude Protein = % Nitrogen x 6.25 (correction factor).

2.4.3 Crude Fat Determination

Fat was determined using Soxhlet method as described by AOAC (2012). Samples were weighed into a thimble and loose plug fat free cotton wool was fitted into the top of the thimble with its content inserted into the bottom extractor of the Soxhlet apparatus. Flat bottom flask (250ml) of known weight containing 150 – 200ml of 40 – 60°C hexane was fitted to the extractor. The apparatus was heated and fat extracted for 8h. The solvent was recovered and the flask (containing oil and solvent mixture) was transferred into a hot air oven (GENLAB, England B6S, serial no: 85K054) at 105°C for 1 h to remove the residual moisture and to evaporate the solvent. It was later transferred into desiccator to cool for 15 min before weighing. Percentage fat content was calculated as

$$\% \, Crude\ Fat = \frac{weight\ of\ extracted\ fat}{Weight\ of\ Sample} \ x\ 100 \ldots (3)$$

2.4.4 Crude Fibre Determination

The method described by AOAC (2012) was used for fibre determination. Two (2) grams of the sample was extracted using Diethyl ether. This was digested and filtered through the california Buchner system. The resulting residue was dried at 130 ± 2°C for 2 h, cooled in a desicator and weighed. The residue was then transferred in to a muffle furnace (Shanghai box type resistance furnace, No.:SX2-4-10N) and ignited at 550°C for 30 min, cooled and weighed. The percentage crude fibre content was calculated as:

$$\% \, Crude\ fibre = \frac{Loss\ in\ weight\ after\ incineration}{Weight\ of\ original\ food} \times 100 \ldots. (4)$$

2.4.5 Ash Determination

The AOAC (2012) method for determining ash content was used. Two (2) gram of sample was weighed into an ashing dish which had been pre-heated, cooled in a desiccator and weighed soon after reaching room temperature. The crucible and content was then heated in a muffle furnace at 550°C for 6-7 h. The dish was cooled in a desiccator and weighed soon after reaching room temperature. The total ash was calculated as percentage of the original sample weight.

$$\% \, Ash = \frac{(W3-W1)}{(W2-W1)} \ x\ 100 \ldots\ldots\ldots\ldots (5)$$

Where:
W1 = Weight of empty crucible,
W_2 = Weight of crucible + sample before ashing,
W_3 = Weight of crucible + content after ashing.

2.4.6 Carbohydrate Determination

Carbohydrate content was determined by difference according to Ihekoronye and Ngoddy (1985) as follows:

$$\%\,Carbohydrate = 100 - (\%moisture + \%Protein + \%Fat + \%Ash + \%Fibre) \ldots\ldots 6$$

2.4.7 Calorific Content Determination

The values obtained for protein, fat and carbohydrate were used to calculate the calorific content value of the sample as expressed below.
Protein content (%) = p
Fat content (%) = F
Carbohydrate content (%) = C

$$Caloric\ value\ (Kcal/100g) = P \times 4.0 + F \times 9.0 + C \times 3.75 \ldots\ldots\ldots 7$$

2.5 Microbiological Analysis

Microbiological analysis was done according to Guan, (2009). Isolation and enumeration of bacteria were done by observing growth in selective media. For Standard Plate Count, portion of cheese were diluted as 1:10 using sterile phosphate buffer which were subsequently diluted with the same as needed and then enumerated for total viable count using nutrient agar. Since this is a onetime study, 3-6 samples were taken and surface plates were made in triplicates in appropriate selective media. Bacterial isolation was performed by pour plate method and fungal isolation was performed by spread plate method. Both bacterial and fungal enumerations were expressed as colony forming units (cfu) per ml. In all the cases counts were made up to 48 hours.

2.6 Antioxidant Properties

2.6.1 DPPH Scavenging Activity

The scavenging activity of HPH and its fractions against the SPPH radical was determined using a previously described method (AOAC, 2012) with slight modification for a 96-well clear flat-bottom plate. Peptide samples were dissolved in 0.M sodium phosphate buffer, pH 7.0 containing 1% (w/v) Triton X-100. DPPH was dissolved in methanol to a final concentration of 100uM. Peptide samples (100 uL) was mixed with uL of the DPPH solution in the 96-well plate to a final assay concentration of 1 mg/mL and incubated at room temperature in the dark for 30 min. The absorbance values of the control (Ac) and samples (As) were measured at 517 nm. The control consists of sodium phosphate buffer in place of the peptide sample while Glutathione (GSH) was used as the positive control. The percent DPPH radical scavenging activity of the samples was determined using the following equation:

DPPH radical scavenging activity (%)=[(Ac–As)/A_s]*100

2.6.2 Ferric Reducing Antioxidant Power

The reducing power of peptide samples was measured according to a previously reported method (AOAC, 2012) was modified as follows. Peptide samples (250 uL) dissolved in 0.2 M sodium phosphate buffer at pH 6.6 or double distilled water (control) was mixed with 250 uL of buffer and 250 uL of 1% potassium ferricyanide solution. The final peptide concentration in the assay mixture was 1 mg/mL. The resulting mixture was heated to 50^0 C and incubated for 20 min. After incubation, 250 uL of 10 % aqueous TCA was added. Thereafter, 250 uL of piptide/TCA mixture was combined with 50 uL of 0.1 % ferric chloride and 200 uL of water and allowed to stand at room temperature for 10 min. The solution was centrifuged at 1000g and 200 uL of the supernatant transferred to a clear bottom 96-well plate. The absorbance of the supernatant was measured at 700 nm.

2.6.3 Chelation of metal ions

The metal chelating activity was measured using a modified method described by AOAC (2012). Peptide sample solution or GSH (Final assay concentration of 1 mg/mL) was combined with 0.05 mL of 2 mM $FeCl_2$ and 1.85 mL double distilled water in a reaction tube. Ferrozine solution was added and mixed thoroughly. The mixture was allowed to stand at room temperature for 10 min from which an aliquot of 200 uL was removed and added to a clear bottom 96-well plate. A control was conducted by replacing the sample with 1 mL of double distilled water. The absorbance values of (Ac) and (As) at 562 nm was measured using a spectrophotometer and the metal chelating effect (%) was calculated using the following:
Metal chelating effect (%) = [Ac-As)/Ac]* 100

2.6.4 Lipid Peroxidation Activity

Linoleic acid oxidation was measured using the method described by (AOAC, 2012) Peptide samples was dissolved in 1.5 mL of 0.1 M sodium phosphate buffer (pH 7.0) and the mixture added to 1 mL of 0.1 M of 50 mM linoleic acid dissolved in 99.5% ethanol. For the control assay, 1.5 mL of buffer was added to the ethanolic linoleic acid solution. The mixtures were kept at 60 ^{o} C in the dark for 7 days. At 24 h intervals, 100 uL of the assay solution was mixed with 4.7 mL of 75% aqueous ethanol, 0.1 mL of ammonia thiocyanate (30% w/v) and 0.1 mL of 0.02 M ferrous chloride dissolved in 1 M HCl. This solution (200 uL) was added to a clear bottom 96-well plate and the degree of color development was measured using the spectrophotometer at 500 nm after 3 min incubation at room temperature. An increased absorbance was simply an increase in the level of linoleic acid oxidation.

2.7 Sensory Evaluation of the soycheese

Sensory evaluation of the soycheese coagulated with the four different coagulants was carried out according to the method described by (Ihekoronye and Ngoddy, 1985).

2.8 Statistical Analysis

The Experimental data were subjected to analysis of variance (ANOVA) and means separated by Fisher's least significance difference test using Genstat statistical package, version 17.0.

3. Results and Discussion

Table 2: Effect of Different Coagulants on the Proximate Composition of Soycheese (%)

Samples	Moisture (%)	Crude protein (%)	Crude fat (%)	Ash (%)	Fibre (%)	Carbohydrate (%)	Energy (%)
A	39.16^{d}±0.05	13.93^{d}±0.09	23.34^{a}±0.16	1.34^{b}±0.02	5.15^{b}±0.05	17.10^{a}±0.08	329.88^{a}±0.71
B	41.08^{b}±0.01	15.86^{bc}±0.70	20.22^{b}±0.04	1.38^{b}±0.01	4.64^{c}±0.01	16.32^{b}±0.04	308.57^{e}±0.16
C	38.88^{e}±0.01	16.78^{a}±0.04	21.33^{c}±0.04	1.74^{a}±0.00	4.34^{d}±0.02	16.88^{a}±0.10	322.62^{b}±0.32
D	42.92^{a}±0.08	15.33^{c}±0.01	22.37^{b}±0.01	1.31^{b}±0.11	5.52^{a}±0.22	12.72^{c}±0.19	310.32^{d}±0.81
E	39.78^{c}±0.1	16.27^{ab}±0.1	21.38^{c}±0.04	1.31^{b}±0.03	5.03^{b}±0.02	16.24^{b}±0.21	318.45^{c}±0.13
LSD	0.15	0.83	0.20	0.14	0.26	0.36	1.31

Values are means ±S.D of triplicate determinations. Values on the same column with different superscripts are significantly different ($p < 0.05$)

KEY: A= Soursop Coagulated Soycheese, B= Passion Fruit Coagulated Soycheese C= Baobab Coagulated Soycheese, D= Pineapple coagulated Soycheese, E= Tamarind Coagulated Soycheese

3.1 Proximate Composition (%) of Soy Cheese

The results of the proximate composition of soy cheese produced from different coagulants are presented in table 3. There was significant different ($p<0.05$) in the moisture content among the samples. Maijalo *et al*., (2016), Omotosho *et al*., (2011), Oboh and Omotosho (2005), Shokunbi *et al*., (2011) reported higher moisture contents but Orhevba and Taiwo (2016) reported a similar range of moisture content. The variation in the moisture content of tofu prepared with different coagulants was probably due to the differences in gel network within the tofu particles that was influenced by different anions and its ionic strengths toward the water holding capacity of soy protein gels (Yakubu and Amuzat, 2012). The high protein content of baobab coagulated cheese could possibly be attributed to the high protein content of baobab. (Obizoba and Ameachi, 1993) and (Sena et al., 1998) reported 15.3 g/100g and 17 g/100g baobab protein values respectively. Sample A recorded the highest fat content followed by sample D and sample B recorded the lowest fat content. There was no significant difference between samples B and D in their fat contents and also, there was no significant difference between samples C and E in their fat contents. The highest ash content was found in sample C which was the baobab coagulated soy cheese and the lowest was in samples D and E. there was no significant difference between samples A, B, D and E. samples D and E recorded the same values of ash content. The fibre content of pineapple coagulated soycheese, is significantly ($p< 0.05$) higher than other coagulated soy cheese. This is followed by soursop coagulated soy cheese which recorded a value of (5.15%). Baobab coagulated soy cheese (4.34%) had the lowest fibre content. There was no significant ($p<0.05$) difference between the soursop and tamarind coagulated soy cheeses. The low fibre content could be due to the soybean low fibre content (Ogbemudia *et al*., 2018). The energy content of the cheese produced using soursop (329.88 Cal/g) was significantly ($p<0.05$) higher than the energy contents of soycheese produced by passion fruit (308.57 Cal/g), baobab (322.62 Cal/g), pineapple (310.32Cal/g) and tamarind (318.45Cal/g). There was no significant difference ($p<0.05$) among the samples in their energy contents. The basis for the high energy contents of the soy cheese could not be categorically stated, however, it could be attributed to the fact that soy cheese is very rich in protein and fat (Prestamo *et al*., 2002), which are energy producing macromolecules.

Table 3: Effects of Different Coagulants on the Microbial Load of Soycheese (Cfu/ml)

	Parameter	
SAMPLES	Total Viable Count	Fungi Count
A	1.1×10^{1c}±0.00	5.3×10^{2b}±1.41
B	1.6×10^{1c}±0.28	6.6×10^{2a}±2.82
C	1.2×10^{2c}±0.28	3.5×10^{2d}±1.41
D	9.0×10^{1b}±1.41	2.9×10^{2e}±1.41
E	1.2×10^{2a}±1.41	4.6×10^{2}±00^{c}±0.00
LSD	2.83	4.30

Values are means ±S.D of triplicate determinations. Values on the same column with different superscripts are significantly different ($p < 0.05$)

KEY: A= Soursop Coagulated Soycheese, B= Passion Fruit Coagulated Soycheese, C= Baobab Coagulated Soycheese, D= Pineapple coagulated Soycheese, E= Tamarind Coagulated Soycheese

3.2 Microbial Load of soycheese

The result of the microbial load of the various cheese produced with various coagulants is shown in Table 3. Among the products coagulated with different coagulants, the baobab (1.2×10^{2} Cfu/ml) and tamarind (1.2×10^{2} Cfu/ml) coagulated soycheese recorded the highest total viable count. This was followed by the pineapple (9.0×10^{1} Cfu/ml) coagulated soycheese and the lowest was recorded in the soursop (1.1×10^{1}cfu/ml) coagulated soycheese. There was significant difference ($p<0.05$) in the total viable counts of the soycheese. Yohannes and Alemayehu (2016) reported higher microbial load (2.082×10^{2} - 6.067×10^{3} Cfu/ml) in soycheese. The passion fruit (6.6×10^{2} Cfu/ml) coagulated soycheese recorded the highest fungi count while the pineapple coagulated soycheese recorded the lowest fungi count. There was no significant difference ($p<0.05$) among the soycheese in their fungi count.

Table 4: Effects of Different Coagulants on the Anti-Oxidants Properties (µMol/L) of Soycheese

	PARAMETER			
Sample	DPPH	FRAP	ABTS	ORAC
A	806.66^{d}±6.31	435.74^{c}±5.09	725.79^{c}±8.97	630.26^{e}±4.13
B	935.98^{b}±4.84	346.70^{d}±3.22	1353.50^{b}±0.97	794.74^{c}±6.49
C	1131.12^{a}±1.74	1541.08^{a}±1.56	1765.60^{a}±1.95	1327.44^{a}±6.45
D	831.78^{c}±0.78	294.34^{e}±7.07	596.63^{e}±0.70	865.88^{b}±39.79
E	741.32^{e}±2.70	532.82^{b}±2.25	674.18^{d}±2.17	713.77^{d}±2.34
LSD	9.91	11.13	10.93	47.21

Values are means ±S.D of triplicate determinations. Values on the same column with different superscripts are significantly different ($p < 0.05$).

KEY: A= Soursop Coagulated Soycheese, B= Passion Fruit Coagulated Soycheese .C= Baobab Coagulated Soycheese, D= Pineapple coagulated Soycheese. E= Tamarind Coagulated Soycheese

DPPH=radical scavenging antioxidant activity. FRAP= Ferric ion reducing antioxidant power, ABTS=Trolox equivalent antioxidant, ORAC=Oxygen radical absorbance capacity.

3.3 Anti-Oxidants Properties (µMol/L) of Soycheese

The result of the anti-oxidants properties of the soycheese is shown in table 4. The result showed significant difference ($p<0.05$) in the DPPH contents among the samples. The baobab (1131.12 µMol/L) coagulated soycheese showed highest value of DPPH while the tamarind (741.32 µMol/L) showed the lowest value of DPPH. There was also significant difference ($p<0.05$) between the various products in their FRAP contents but the baobab (1541.08 µMol/L) coagulated soycheese recorded the highest value followed by the tamarind (532.82 µMol/L), soursop (435.74 µMol/L), then the passion fruit (346.70 µMol/L) coagulated soycheese while the pineapple (294.34 µMol/L) coagulated soycheese recorded the lowest FRAP value. The baobab (1765.60 µMol/L) coagulated soycheese was significantly ($p<0.05$) higher than other samples in their ABTS contents and the result showed significant differences in the ABTS value. The least value was recorded in the pineapple (596.63 µMol/L) coagulated soycheese. In the ORAC values, significant differences ($p<0.05$) existed between the products coagulated with different coagulants. The highest was in baobab (1327.44 µMol/L) coagulated soycheese followed by the pineapple (865.88 µMol/L) coagulated soycheese and the lowest was in the soursop (630.26 µMol/L) coagulated soycheese

Table 5: Effect of Different Coagulants on Sensory Properties of Soycheese

SAMPLES	Taste	Appearance	Aroma	Texture	General Acceptability
A	7.55^{a}±1.05	7.80^{ab}±1.10	8.20^{a}±0.77	7.55^{a}±1.05	8.25^{a}±0.78
B	7.50^{a}± 1.23	7.10^{c}±1.02	8.10^{a}±1.07	7.50^{a}±1.24	7.30^{c}±0.86
C	7.60^{a}±0.94	7.35^{bc}±1.08	8.00^{a}±0.91	7.60^{a}±0.94	7.60^{bc}±0.75
D	7.35^{a}±1.03	8.05^{a}±0.76	7.95^{a}±1.15	7.35^{a}±1.04	7.95^{ab}±0.99
E	7.50^{a}±1.10	7.20^{bc}±0.89	7.30^{b}±1.12	7.50±0.94	7.55^{bc}±0.94
LSD	0.40	0.52	0.53	0.55	0.46

Values are means ±S.D of triplicate determinations. Values on the same column with different superscripts are significantly different ($p < 0.05$).
KEY: A= Soursop Coagulated Soycheese, B= Passion Fruit Coagulated Soycheese, C= Baobab Coagulated Soycheese, D= Pineapple coagulated Soycheese, E= Tamarind Coagulated Soycheese

3.4 Sensory Properties of Soycheese.

The sensory result revealed that there was no significant difference ($p<0.05$) in the taste and textural scores of the samples though the soursop (7.55 and 7.55) coagulated soycheese had the highest contents scores while the pineapple (7.35 and 7.35) coagulated soycheese had the lowest contents, respectively. This showed that the coagulants did not greatly affect the taste of the soymilk used in the processing of the soycheese. The result recorded a significant difference ($p<0.05$) in the appearance of the soycheese. The highest content was observed in the pineapple (8.05) coagulated soycheese which was significantly ($p<0.05$) higher than those coagulated with soursop (7.80), passion fruit (7.10), baobab (7.35) and tamarind (7.20). In terms of aroma contents of the soycheese, there was no significant different ($p<0.05$) between the soursop (8.20), passion fruit (8.10), baobab (8.00) and pineapple (7.95) coagulated soycheese but significant difference existed between these aforementioned samples and the tamarind (7.30) coagulated soycheese. The soursop coagulated soycheese had the highest general acceptability followed by the pineapple coagulated soycheese. The passion fruit coagulated soycheese had the least general acceptability.

4. Conclusion

The results showed that acceptable soycheese produced from locally sourced plant based coagulants seem to have better nutritional quality, proximate, microbiological, antioxidants and sensory qualities of soycheese. It has also been demonstrated that soycheese produced from baobab fruit coagulant had higher protein, and highest antioxidants properties.

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