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Production of Soy Cheese from Vegetable Protein Using Different Coagulants

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Abstract

The purpose of the study was to examine the effect of using locally untapped coagulants on the chemical composition of production of soy cheese from vegetable protein. The coagulants consisted of sample coded "Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5% alum solution (ALS). The soy cheese were produced by adding sliced100g of Sodom apple leave into 1000ml of soy beverage [1], 100ml of Sodom apple leave extract was added into 1000ml of soy beverage [2], 100ml of corn steeped liquor was added into 1000ml of soy beverage [3], and 100ml of 0.5% alum solution was added into 1000ml of soy beverage [4]. Chemical parameter consisted of protein ranged from 40.66- 40.88%, moisture ranged from 6.32-6.86%, fat ranged from 8.25-8.30%, fibre 0.45-0.54%, CHO ranged from 41.61-42.33%, caloric values ranged from 396-398 Kcal but no significant different was found $p < 0.05$. Chemical compositions of soy cheese produced were excellent, nutritionally adequate and meet daily human requirement, soy cheese vegetable examined for aerobic count, coliform cfu/g were nil respectively.

Corn steeped liquor coagulant has been confirmed that it contained chemical, physico- chemical and natural micronutrients such as sodium, calcium magnesium that enhanced coagulations to give high yield, better taste colour compared with other coagulants. Corn steeped liquor coagulant were overall preferred compared with coagulants $p > 0.05$.

Keywords: Cheese; Vegetable protein; Sodom apple leave; Corn steeped liquor

Introduction

Cheese is a dairy product made from pressed milk curds produced mainly from animal milk throughout the world where animal production is available. Different types of cheese are made from unripened (fresh) or ripened (aged) cheese [5]. Cheese could be produced from animal or plant protein sources. The major ingredient of plant cheese is soybean belonging to *Glycine max* (L.) Merrill, family *Leguminosae* [6]. The soybean is limiting in amino acids that containing sulphur (methionine and cystine). Protein percentage in soybean is about 70% compared with that of whole egg protein [6]. In tropics where animal protein is limited, expensive and scarce, soybean meal is representing a plant protein, is available, and could be supplement to cereal foods where lysine is limiting [7,8]. Soybean protein products have unique functional properties, the functional characteristics include the ability of the proteins to thicken (viscosity), emulsify, form gels, foam, produce films and sulphur, absorb water and/or fat and create meat-like texturized structures [6]. Many of the foods were derived from soybean products are based on the excellent functional properties of soybean proteins [6]. Some worker have reported lipids of soybeans (crude soybean oil) to consist of 96% triglycerides, 2% phospholipids, 1.6% unsaponifiables, 0.5% free fatty acids and minute amounts of carotenoid pigments [3]. Carbohydrates content of soybeans were amounting to 30%, can be divided into two groups: soluble sugars (sucrose 5%, stachyose 4%, raffinose 1%) and insoluble "fibre" (20%). Raffinose is a trisaccharide composed of galactose, glucose and fructose. The major mineral constituents in soy bean accounts for potassium 1797mg, calcium 277mg and magnesium 280mg. The minor constituents comprised of trace elements of nutritional importance, such as iron15.7 mg, zinc4.89 mg. Soy cheese has been linked with some medical prevention against ailments such as, cow's milk allergy, osteoporosis, high blood pressure and cholesterol [9,10]. However, we aimed to examine the effect of using locally available cheap coagulants on the chemical composition of production of soy cheese from vegetable protein [6]. Although different coagulants have been employed such as lime and sulphate based but to curdle soy cheese from soybean for industrial sustainability and availability hence, this study has embarked on some locally untapped natural available, micro nutrient endowed coagulants like Sodom apple leave and corn steeped liquor to produce cheese.

Material and Methods

Preparations of Corn Steeped Liquor

Corn steeped liquor was prepared according to [11].
Corn steeped liquor is prepared by soaking maize for 72hours, allow to ferment, wet milled with hammer mill, sieve with sieve mesh of 0.21mm, allow to settle down and decant the supernatant.

Preparations of Sodom Apple Leave Extract

100g of Sodom apple leave was obtained from Botanical Garden, Obafemi Awolowo University, Ile-Ife and was macerating into 500ml of water.

Production of Soy Beverage

Four coagulants prepared were Sodom apple leave, Sodom apple leave extract, corn steeped liquor, and 0.5% alum. Soya bean was soaked in 0.5% sodiumbicarbonate at room temperature for 12hr to stop fermentation of soy bean. Then wet soya bean was drained and blanched in 0.05% sodiumbicarbonate solution in a 1:10 ratio. The blanched soybean was drained, dehulled and blended into slurry in a blender by adding water at 2:1 weight by volume. The slurry obtained was strained through a muslin cloth to extract the soya milk [11-13].

Production of Soy Cheese

Soy beverage was boiled for 20-30minutes to remove the anti-nutrient, in the process the odour is liberated and allowed to cool. Coagulants **SAL** 100g Sodom apple leave [1], **SALE** 100ml Sodom apple leave extract [2], **CSL** 100ml corn steeped liquor [3], and **ALS** 100m of 0.5% alum solution [4] were added to 1 liter of soy beverage each. Soy beverage and each coagulant was beverage boiled at 100 °C for 30minutes. Cheeses were produced from vegetable protein, soy cheeses were heated until total soy cheese cuddling was formed, and then whey was allowed to separate from the cheeses [11,12].

Chemical Analysis of Soy Cheese

Proximate component such as proteins, moisture, ash, crude fiber, fat were determined according to official AOAC methods while nitrogen free was determined by difference. The protein content was determined by converting the total nitrogen value through the multiplication by a conversion factor of 6.25 [15].

Total Titratable Acidity

Total titratable acidity (lactic acid base) was determined by titrating with 10ml of 0.1M NaOH against 20 ml diluted with 80 ml of distilled water, and using 2-3 drops of phenolphthalein indicator [15].

$$\%\text{Lactic acid}\left(w/w\right)=\frac{(VOl.of\ \text{NaoH})\,X\ \text{Normality}\,X\ 0.09}{Weight\ of\ \text{samples in g}}X\ 100$$

pH Determination

The pH of soy cheeses was determined using a pH meter (HANNA model HI 8314). Prior to the use of pH meter the samples were standardized with a buffer solution of pH 4.0 and 7, and then poured into a small beaker containing 100ml of soy cheese [15].

Microbial Analysis

1ml of soy cheese was diluted with 9ml of distilled water and this was followed by serial dilutions. The diluted samples were plated on plate count and violet red agars for total aerobic plate and coliform counts respectively. For total aerobic plate count, the plates were incubated at 37 °C for 24 hours while the coliform plates were incubated for 48 hours respectively [11,12].

Sensory Evaluation

For the sensory evaluation, sample soy cheeses were presented to a 25 member panel consisting of students of the Department of Food Science and Technology, Obafemi Awolwolo University, Ile-Ife, Nigeria who were previously trained with the new formulated products. Using a 9-point Hedonic scale, where 1-Dislike extremely, 2-Dislike very much, 3-Dislike moderate, 4-Dislike slightly, 5-Neither like nor dislike,6-Like slightly, 7-like moderately, 8-like very much and 9-Like extremely. The panelists were asked to evaluate for quality attributes such as taste, colour, flavor, Overall acceptability [11,12,14].

Statistical Analysis

Values mean determinations were in triplicates, statistical analysis of the data was carried out using the one-way Analysis of Variance (ANOVA) technique (SPSS 18.0 for windows), and the differences were separated using Duncan's Multiple Range Test (DMRT) at a level considered to be significant at $p<0.05$.

Results and Discussion

Table 1 shows the chemical composition of soy cheese consisted of protein content ranged from 40.66- 40.88% which is quite large to break down to amino acid. Formally reported that soy bean is rich in virtually essential amino acid but limited sulphur amino acid especially methionine and cystine and abundant in lysine[11,12].The moisture content of sample dietary content ranged from 6.32-6.86% this is less than 10% recommended for food, could automatically could keep for longer period hence increase the shelf life; fat content ranged from 8.25-8.30%, it is less than 10% recommended for food, this could reduce the level of rancidity, CHO% ranged from 41.61-42.33% this in line with previous report carbohydrates content of soybeans were amounting to 30%, can be divided into two groups: soluble sugars such as sucrose 5%, stachyose 4%, raffinose 1% and insoluble sugar like raffinose is a trisaccharide composed of galactose, glucose and fructose. It also contained low fiber% of the ranged from 0.45-0.54 hence enhance highly digestibility of the products [16,17]. Caloric value ranged from 396-398 Kcal, soy cheese derives its nutrients from protein, carbohydrate and fat content which are the major source of energy. Soy cheese contain hypolipidemic, ant cholesterol and counteratherogenic, could provide benefit for the consumer due to high nutritional advantages over animal protein [6,13,18]. Soy-cheese contained reduced level of cholersterol saturated fat and source of disaccharides break to glucose free lactose [13,16,17].Soy product could be taken instead of animal product, acts as an alternative milk for children who cannot tolerate human or animal milk [9,15].

Cheese code	Protein%	Moisture%	Fat%	Ash%	Fiber%	CHO%	Caloric valueKcal
SAL	40.78^{d}±0.01	6.86^{a}±0.01	8.30^{a}±0.00	4.45^{a}±0.00	**0.50^{ab}±.01**	39.61^{b}±.02	396^{b}±.00
SALE	40.66^{c}±0.01	6.38^{b}±0.02	8.25^{a}±0.01	4.38^{b}±0.01	0.52±.^{ab}01	40.33^{ab}±.02	398^{a}±.00
CSL	40.88^{a}±0.01	6.34^{b}±0.05	8.26^{a}±0.01	4.36^{c}±0.01	0.54±^{b}.01	40.18^{ab}±.01	398^{a}±.00
ALS	40.80^{b}±0.01	6.32^{c}±0.03	8.28^{a}±0.01	4.34^{c}±0.01	0.45^{b}±.02	40.26^{b}±.01	398^{a}±.00

Values are the mean of three determinations. Different superscripts in a column are significantly different (P<0.05) Samples dietary coded Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5%alum solution (ALS)

Table 1: Chemical composition of soy cheese

Quality attributes of soy cheeses showing taste ranged from 6.25-8, colour ranged from 7-8, flavour 7- 8 and overall acceptability7-8. The taste colour, flavor and overall acceptability of the soy cheeses were ranged from 7.25- 8. Corn steeped liquor (CSL) coagulant ranked the best (p>0.05) compared with other coagulants SAL, SALE, ALS. This corroborated with previous findings that corn steeped liquor contained chemical physico-chemical and micronutrients such as ca, k, and mg that could enhanced coagulations [9,13].

Sample	Taste	Colour	Flavour	Overall Acceptability
SAL	6.25 ^{b}±.50	7.00 ^{a}±.00	7.25 ^{ab}±.00	7.25 ^{ab}±.50
SALE	6.75^{b}±.50	7.00^{a}±.50	7.00^{b}±.50	7.00^{b}±.80
CSL	8.00^{a}±.00	8.00^{a}±.70	8.00^{a}±.60	8.00^{a}±.00
ALS	6.75^{b}±.50	7.25^{a}±.50	6.75^{b}±.50	7.00^{b}±.80

Values are the mean of three determinations. Different superscripts in a column are significantly different (P<0.05) Samples dietary coded Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5%alum solution (ALS)

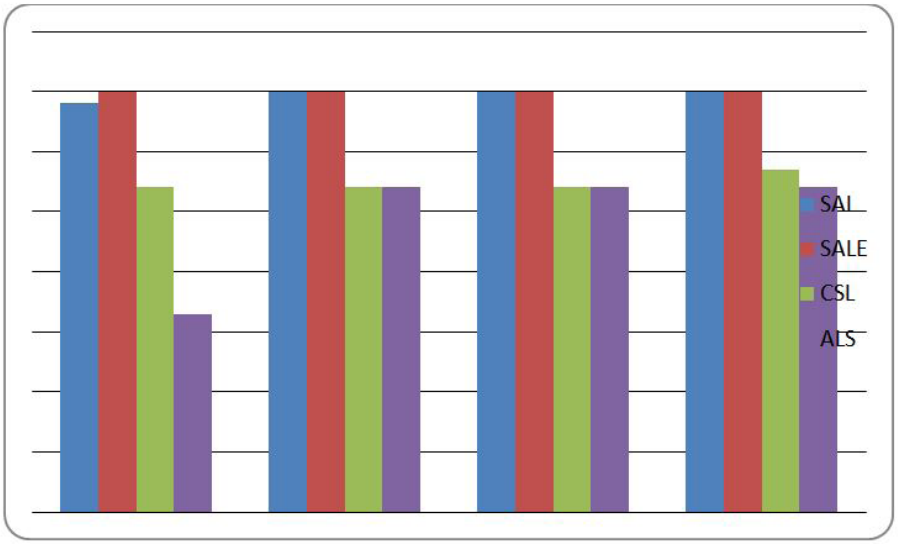
Table 2: Showing the Quality attributes soy cheese

Table 3 revealed the mineral composition soy cheese as follows Kmg/100g ranged from1876-1890, Camg/100g ranged from1876 mg/100g280-286, Mgmg/100g ranged from 274-282, Fe mg/100g ranged from 4.92-4.96 and Cu mg/100g0.30-0.35 respectively. Soy bean contained the lectins otherwise known as hemagglutinins, are proteins which possess the ability to agglutinate red blood cells as have acclaimed by some researchers [13,14,19,20].

Cheese code	K mg/100g	camg/100g	Mg mg/100g	Fe mg/100g	Zn mg/100g	Cu mg/100g
SAL	1890^{a}±1.4	284^{ab}±.00	280^{b}±1.4	15.70^{d}±.04	**4.94^{a}±.01**	.0.35^{a}±.01
SALE	1876^{c}±0.07	280^{c}±1.4	276^{bc}±.7	16.20^{c}±.07	4.92^{b}±.01	0.32^{b}±.01
CSL	1876b^{c}±1.4	286^{a}±1.4	282^{a}±1.4	18.65^{a}±.03	4.96^{a}±.01	0.34^{ab}±.01
ALS	1890^{a}±.7	280^{bc}±1.4	274^{c}±1.4	18.45^{b}±.03	4.90^{b}±.01	0.30^{b}±.01

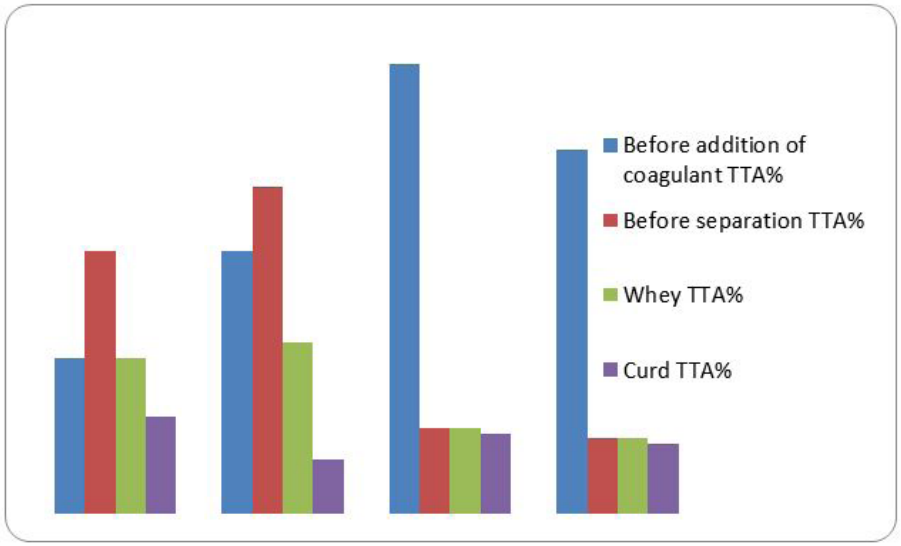
Values are the mean of three determinations. Different superscripts in a column are significantly different (P < 0.05) Samples dietary coded Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5%alum solution (ALS)

Table 3: Mineral composition soy cheese



Values are the mean of three determinations. Different superscripts in a column are significantly different (P<0.05) Samples dietary coded Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5% alum solution (ALS)

Figure 1: Biochemical changes during cheese production (pH)



Values are the mean of three determinations. Different superscripts in a column are significantly different (P<0.05) Samples dietary coded Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5% alum solution (ALS)

Figure 2: Biochemical changes during cheese production (TTA %)

Figures1 and 2 Showed the Biochemical Changes During Cheese Production

Biochemical changes of soy cheese as per lactic acid of soy cheese ranged from 0.10-0.84; these confirmed the previous findings that fermentation occurrences during processing reduce the lactose/lactic acid. pH values ranged from 3.32- 7 for cheese dietary "Sodom apple leave (SAL), Sodom apple leave extract (SALE), corn steeped liquor (CSL) and 0.5%alum solution (ALS) respectively, these support the previous findings that Increasing in pH during curing encourages activity of both proteases and lipases on and the prevention of hypertension [14,16,21].

Cheese code	Aerobic count(cfu/g)	Coliform counts
SAL	- x 10^{-2}	- x 10^{-2}
SALE	- x 10^{-2}	- x 10^{-2}
CSL	- x 10^{-2}	- x 10^{-2}
ALS	- x 10^{-2}	- x 10^{-2}

Microbial counts of the soy cheese were tabulated on table 4 above, aerobic count cfu/g and coliform counts were nil respectively at dilution of lowest of dilution 10^{-1} and highest dilution of 10^{-3} dilutions, which indicated that soy cheese samples coded **SAL**, **SALE**, **CSL**, and **ALS** were safe and free of microbial loads for human consumption [11-13, 22]

Table 4: Microbial counts of the soy cheese aerobic count CFU/g and coliform counts

Conclusion

Corn steeped liquor coagulant has been confirmed that it contained chemical, physico-chemical and natural micronutrients such as sodium, calcium magnesium that is bio active generated and enhanced coagulations to give high yield, better taste, colour compared with others. Corn steeped liquor coagulant had overall acceptability. Corn steeped liquor coagulant has reduce the cost of purchasing sulphate, chloride and health outcomes that may attach. However, soy cheeses produced from vegetable protein were foods that are valuable to vegetarians, alternative to animal protein and gives hope to cow's milk allergy patients. Soy cheese produced from corn steeped liquor is available, sustainable, added nutrient to foods to make a balance diet. Soy cheese vegetable protein is sort of supplementing of lysine to cereal based foods and microbe safe for human consumption. It could be served as low cost protein source for underdeveloped, developing and developed countries.

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