Sensory Evaluation Of Cheese Produced From Nigeria Dwarf Goat Milk, Cow Milk and their Combination Using *Brevibacterium linens* as COAGULANT.

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ABSTRACT

Brevibacterium linens come from the milk or from ripening cultures that are widely used in the cheese industry. This study investigated sensory quality of cheese produced from Nigeria dwarf goat milk, cow milk and their combination using *B.linens* as coagulant. *Brevibacterium linens* was isolated from samples of milk. Milks were filtered and pasteurized at 90 ± 1 ºC for 10 min followed by direct acidification with *Brevibacterium linens* . The vats were incubated at 36 ºC and gel was pressed, drained, cut, salted and package. The samples were analyzed for proximate composition using standard laboratory procedures. All the cheeses produced from *B. linens* as coagulant was significantly (P > 0.05) different when compared with control. The mean value for moisture content, fat, protein, ash and energy, were ranged: 43.22-52.01%, 12.33-14.01%, 17.84-19.04%, respectively.

Keywords: Cheese, Nigeria dwarf goat milk, Cow milk, *Brevibacterium linens*, Coagulant.

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1. INTRODUCTION

Milk is regarded as an important food for infant and adolescent. This is due to the fact that milk serves as a good source of nutrients. It is equally an excellent medium for microbial growth (Akinyele, Fawole, & Akinyosoye, 1999). Milk intended for use in cheese production must be stored at 40ºC and transported to factory where it is stored in insulated silos until it is used (FAO, 2008). Cheese is a dairy product produced by coagulation of milk using acid or rennet, stirring and heating the curd, draining off whey, pressing the curd. It is further ripened or cured to obtain the final product. The essential ingredients in cheese making are milk and coagulants. Ripening or curing of the curd is one of steps in the development of texture and flavour of cheese (Ozcan & Kurdal, 2012). Cheese can also be made by coagulation of whole milk, skimmed milk, or full cream milk (Bodyfelt, Tobias, & Trout, 1998). The type of coagulant used depends on type of cheese so desired. Cheese is made most commonly from pasteurized cow milk, but the milk of other mammals may be used, such as;goat, cow, sheep, buffalos, camels, yaks etc. In Nigeria, milk production is mainly practised by the Fulani nomadic people who are pastoralists involved in the rearing of cattle and moving from one location to another in search of green pasture. Due to lack of refrigeration facilities, the Fulani women process the surplus fresh milk into a soft, un-ripened Cheese called "*Warankasi*" or "*Wara"* (Adetunji and Babalobi, 2011).

The shelf life of cheese varies from 4-7 days depends largely on variety. Therefore, cheese is a form of milk that is solidified to preserve its valuable nutrients (O' Connor, 1993). The principle of cheese processing is based on the coagulation of the protein in milk; during which about 90% of the milk fat is entrapped (Ogunlade *et al*., 2019).The coagulated mass is the curd; while the remaining liquid is called whey (Ogunlade *et al.,* 2019). Curd (cheese) consists mainly of milk proteins (casein) and milk fat; while whey mainly contains water, milk sugar (lactose), protein (serum proteins) and B vitamins (O'Connor, 1993).

One of the key ingredients in cheese making is coagulant and rennin which serves as coagulants from animal origin is the commonest coagulant used (Roseiro *et al*., 2003*)*. To large extent, the yield and quality of cheese is determined by the quality of milk and the type of coagulants used, and several plant coagulant such as *Cynara cardunculus,* sun flower, Moringa extract, pineapple,papaya, *Calotropis procera* (Sodom apple) and so on, have been used to clot milk (Aworth and Muller,1987). In recent development, it has been observed that milk coagulants of plant origin have over-ridden the use animal rennin. The reason being that animal rennin may be limited for diet (vegetarianism), religious reasons (Judaism),or being genetically engineer food, of which the Germans and Dutch for example, forbid the use of recombinant calf rennin (Roseiro *et al*., 2003).

Brevibacterium linens has long been recognized as an important dairy microorganism because of its ubiquitous presence on the surface of a variety of smear surface-ripened cheese such as Limburger, Munster, Brick, Tilsiter and Appenzeller (Motta and Brandelli, 2008). The growth of *B.linens* on the surface is thought to be an essential prerequisite for the development of the characteristic colour, flavor and aroma of smear surface-ripened cheeses (Ades and Cone, 2009). *Brevibacterium* are of interest to the food industry because they produce amino acids such as glutamic acid which is of use in the production of flavour enhancer such as monosodium glutamate. They also produce important enzymes used in cheese ripening. *Brevibacterium linens* is the type strain and has a growth temperature range of 8–37 °C and an optimum of 21–23 °C (Motta and Brandelli, 2008). *Brevibacterium* have also been isolated from wheat samples (Rattray and Fox 1999).*B.linens* produces red or orange or purple-coloured pigment of aromatic carotenoide type which are not common in other bacteria.

This alcalophilic bacterium is able to produce methanethiol fromL-methionine and tolerate a high NaCl concentration up to 15%, *B.linens* produces antimicrobial substances which inhibits the growth many gram positive food poisoning bacteria as well as several yeasts and moulds. *B.linens* synthesizes highly active and multiple proteolytic enzymes during its growth. In acceleration of cheese ripening process, it is possible to improve flavor and eliminate bitterness with the use of enzymes (peptide) from *B.linens* alone or in combination with commercially available enzymes (Motta and Brandelli, 2008). The contribution of *Brevibacterium* towards cheese production has been under investigation for some time, showing that it can break down lipids and proteins (i.e. casein) with the use of extracellular proteases and lipases, (Rattray and Fox, (1999), Ozturkoglu-Budak *et al*., 2016) . Many *Brevibacterium* isolates also have the ability to modify sulfur-containing amino acids to produce volatile sulfur compounds which are important for flavor development, (Amarita *et al*., 2004, Yvon *et al*., 2000, Bonnarme, Psoni and Spinnler, (2000)). *Brevibacterium* strains are thus often used as surface-ripening cultures in many different cheese types, (Bockelmann *et al*., 2005). Understanding the functional potential of cheese bacteria is essential in the combined effort with cheese producers to shorten ripening times, reduce spoilage, better control cheese aroma, and increase food safety. Therefore, this study aimed to investigate the sensory evaluation of cheese produced from Nigeria dwarf goat, cow milk and their combination using *B.linens* as coagulant.

2.0 MATERIALS AND METHODS

2.1 Source of Milk

Fresh Nigeria dwarf goat milk and cow milk were purchased from National Veterinary Research Institute (Vom) in division of Animal Health and Production Technology, (AHPT), Jos Plateau State, Nigeria. Milk samples were then kept in an ice box immediately after collection. The sample of cheese used as control was purchased from food chemical shop in Jos metropolis.

2.2Isolation of Brevibacterium linens from milk sample

Brevibactrium linens were isolated and characterized from sample milk. Prior to isolation of *Brevibacterium linens*, 5ml of each milk samples (goat and cow milks) were weighed and thawed in the dark at 4^{o}C. The smear were collected from milk samples, by scraping the surface of the milk and weighed. The culture was grown in 250ml Erlenmeyer flask containing 50ml of a medium composed of 20g/L D-glucose (Carloerba, London), 5g/L casamino acids (Difco), 1g/L yeast extracts (Biokar), 5g/L NaCl and 1g/L KH_2PO4. The pH was adjusted to 6.9 and the medium was sterilized at 121^{o}C for 15minutes and incubated at 25^{o}C for 48hours with stirring (150rpm) to oxygenate the medium (Galaup *et al.*, 2005).

2.3 Sample preparation

2.3.1Production of cheese

Three different cheese types were made from two samples of fresh milk: CCM (cheese made from cow's milk), CGM (cheese made from goat's milk) and CCGM (cheese made from cow's milk and goat's milk, 1:1 ratio, L:L). The cheeses were produced using the method described by Adetunji and Babalobi, (2011). 500ml of each sample of milks were filtered and pasteurized at 90 ± 1 ^{o}C for 10 min followed by direct acidifying/inoculating with 10ml/l *Brevibacterium linens* .The vats were incubated at 36 ^{o}C until a firm curd was formed (approximately 40 min). The obtained gel was allowed to drain, press, gently cut into cubes, salted in brine (12 g/L NaCl), placed in perforated rectangular containers (approximate capacity of 250 g) and maintained at 10 ^{o}C under pressure for 4 h and vacuum packaged. The cheese obtained after storage at 10 ^{o}C for 24h was regarded as the final product.

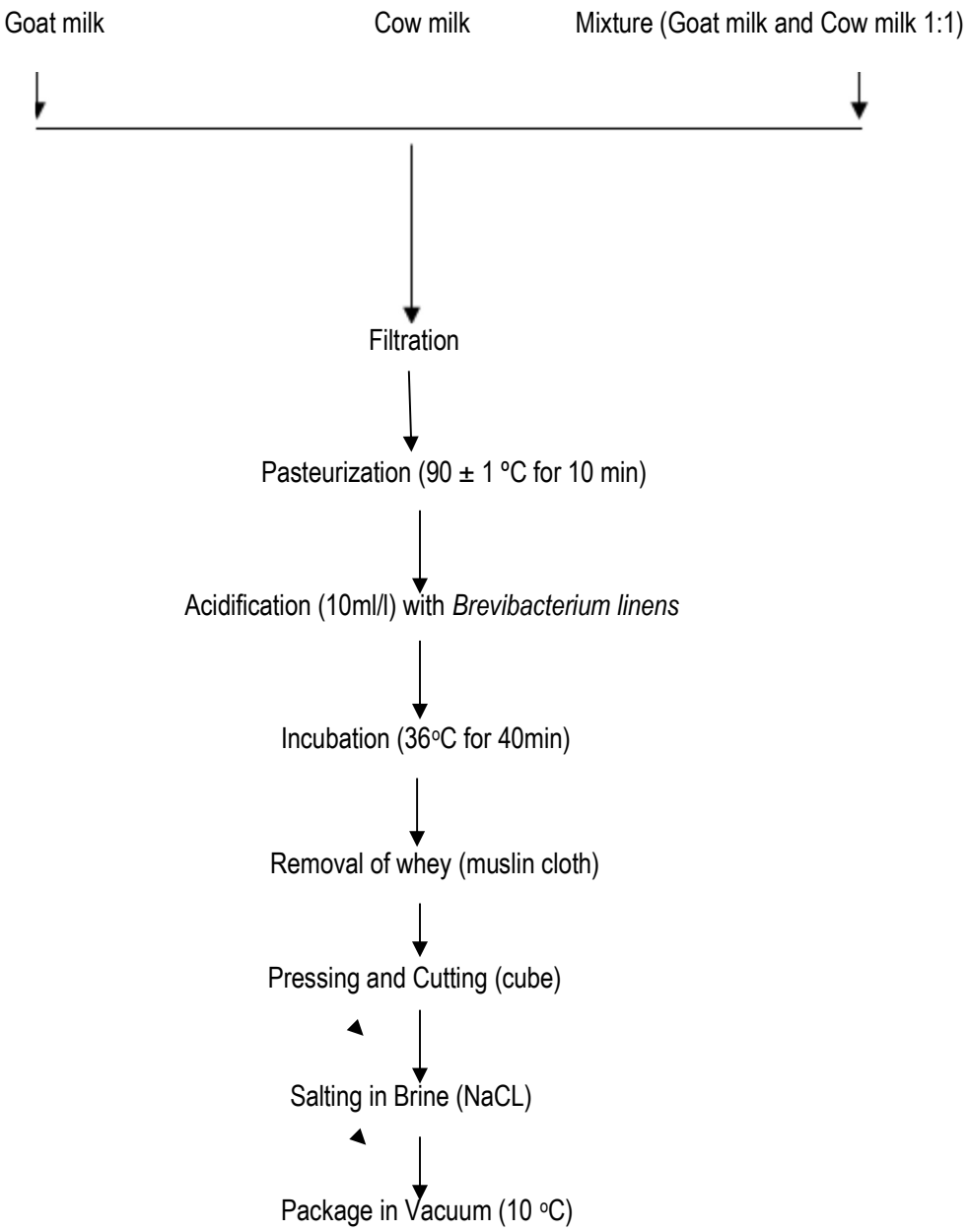

Figure 1: flowchart for the production of goat milk, cow milk and their mixture cheese.

2.4 Determination of proximate composition of milk.

The moisture, crude protein, crude fat and total ash contents of the milk and cheese samples were determined according to the standard methods of AOAC (2012). The carbohydrate content was determined as shown below:

% Carbohydrate = 100%–(% moisture + %protein + % fat + % ash), (Akume *et al*., 2019).

2.5 Sensory evaluation

Sensory evaluation was conducted using a trained panel consisting of twenty members who are familiar with cheese. The Panelists were instructed to evaluate the coded samples for appearance, aroma, taste, texture, and overall acceptability. Each sensory attribute was rated on a 9- point hedonic scale (9 = like extremely and 1 = dislike extremely) (Ekanem and Ojimehkwe, 2017).Cheese samples were served in 3-digit coded white plastics. The order of presentation of samples to the panelists was randomized. Sensory evaluation was carried out under controlled conditions of lighting and ventilation.

2.6 Statistical analyses

The data obtained were subjected to Analysis of Variance (ANOVA), while Duncan Multiple range test was used to separate means where significant differences existed, data analyses was achieved using the Statistical Package for Social Statistics (SPSS) software version 20.0. All analyses were performed in triplicate determination.

Table 1: Proximate composition of fresh milk samples from Goat, Cow and mixture of Goat- cow milks

Sample	% Moisture	%Fat	(%)Protein	% Ash	Energy
GTM	87.11± 0.02	4.45± 0.03	3.84 ±0.01	0.84 ± 0.01	65.45 ±0.02
CWM	87.09± 0.01	4.2 0 ±0.02	3.35 ± 0.04	0.72 ± 0.04	63.80 ± 0.01
MGC	88.71 ±0.02	3.91 ±0.02	3.62 ± 0.02	0.64 ± 0.02	68.52 ± 0.02

GTM: Nigeria dwarf Goat milk, CW: Cow milk, MGC: mixture of goat and cow milk. Values are means ± SD of triplicate determination

Table1, show the result of the proximate composition of the milk samples from Nigeria dwarf goat milk, cow milk and its mixture. The quality of the raw milk is the single most important criterion that determines the quality of the end product. The quality of the raw fresh milk in turn is dependent on the sanitary procedures followed during the milk production and handling (Igwegbe *et al*., 2015) The moisture content of the milk samples ranged from 88.7% - 86.1%, with goat milk having the highest value. There was no significant ($P < 0.05$) variation between the moisture content of milk from goat milk and cow milk samples. The moisture content for all milk samples were within the range (87.09% - 88.71%) which correlates with results reported by (Ladokun and Oni, 2014). High moisture content indicates high water activity which supports microbial growth and subsequent reduction the shelf life of the milk (Ajai *et al.,* 2012).

Low moisture content on the other hand, implies low water activity which results in reduction of microbial growth and increased shelf life of milk (Ajai *et al.,* 2012). The percentage of protein in goat milk was highest followed by mixture of goat-cow milk and cow milk respectively. Research finding of (Raynal-Ljutovac *et al*., 2008). Showed that goat milk contains a relatively large amount of free amino acids particularly of non -protein amino acid taurine (obtained biosynthetically from cysteine) at 9mg/100g. This is 20-fold more than in cow milk and this similar to the level in human milk. The goat milk had the highest fat content followed by mixture cow milk sample. However, goat milk is rich in short and medium- chain fat 6-10 carbon atoms, containing up to twice as much as cow milk (Sanz Sampelayo *et al*., 2007).

These fats have a different metabolism to that of long- chain fat and a source of rapidly available energy, particularly relevant for people suffering from malnutrition or fat absorption syndrome and in the diets of pre-term babies (feeding formulas for premature infants often contain medium-chain triacylglycerol) and elderly people (Raynal-Ljutovac *et al*., 2008). High fat content in food is an indication of more total energies available (Udeozor, 2012). The ash content of the milk samples showed significant (P>0.05) difference with goat and cow milk showing highest and lowest values mixture of goat-cow milk respectively. Ash content in food is an indication of its total mineral element content (Akume *et al*., 2019). There was significant difference (P>0.01) in the carbohydrate content of the goat milk samples compare with cow milk, goat-cow (mixture) milk having the highest value. Aside lactose which occurs as a major carbohydrate in cow milk, there is also small amounts of glucose, gelatos and others. Carbohydrate contributes to the bulk of energy found in be the milk. The calories are provided by the protein, fat and carbohydrate which can help to meet the energy requirement. However, goat milk exhibits beneficial virtues for individuals with certain dietetic problems, thus it is recommended traditional by physicians for infant and others allergic to other milks. Similarly it has been used in treatment of ulcers (Kumar *et al*., 2012).

3.2 Sensory attribute of cheese produced from Nigeria dwarf goat milk, cow milk and their mixture

Table 2: Sensory attribute of cheese produced from Nigeria dwarf goat milk cow milk and their mixture

Sample	Appearance (colour)	Aroma	Taste	Texture	Overall acceptability
GC	8.87 ± 0.12	7.22 ± 0.04	7.84 ± 0.01	8.44 ±0.07	7.98 ±0.02
CC	8.24 ± 0.07	8.09 ±0.14	8.62 ± 0.02	8.27 ± 0.04	8.67 ±0.02
MC	7.32± 0.02	7.45±0.02	7.76±0.01	8.50 ±0.03	8.18 ±0.04
CS	8.00± 0.08	8.01± 0.01	8.04 ± 0.02	8.04 ± 0.06	8.05 ±0.04

Sensory assessment as judged by 20 taste panelists is presented in Table 2 as means of the scores. The sensory attribute of cheese is a combination of the flavour, colour (appearance), taste and texture (the mouth feel). The cheese made from Nigeria dwarf goat milk was found to be significantly different (P > 0.05) in colour (appearance) but lower in aroma, taste and overall acceptability (P < 0.05) to those made from cow milk, mixture of goat-cow milk and control sample (Table 2), with average scores of 8.87 ± 0.12 – 7.42 ± 0.02 for colour; 8.09 ± 0.14 - 7.22 ± 0.04 for aroma; .8.62 ± 0.02 – 7.76 ± 0.01 for taste, 8.50 ± 0.03-8.04 ± 0.06 for texture and 8.67±0.02- 7.98 ± 0.02 for overall acceptability respectively. The disparity seen in the result of aroma, taste and overall acceptability in cheese produced from Nigeria dwarf goat milk, may be attributed its'' goaty flavor".

4.0 CONCLUSION

This study has proven the potential of *Brevibacterium linens,* as a coagulant, which contributes to the final appearance, flavour, colour and aroma of cheese. . Many recent studies have purified and identified *Brevibacterium linens,* for application in food technology, which aims to extend food preservation time and treat pathogen disease. Efforts should therefore be intensified toward commercial production of cheese and other dairy products using *Brevibacterium linens,* as a coagulant.

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