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Percentage Yield and Proximate Composition of Cheese Produced from Sheep Milk Using Different Coagulants

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Abstract: West African soft cheese (wara) produced from sheep milk was processed with different coagulants which are *Calotropis procera* leaves, *Carica papaya* leaves, lemon juice and steep water from maize, millet and soghurm. The results of the percentage yield shows that *Calotropis procera* coagulated milk had the highest percentage yield of 25.60% while wara coagulated with steep water from maize had the lowest percentage yield of 3.80%. The proximate analysis was carried out to evaluate the nutritional composition such as: crude protein, crude fibre, fat, moisture and ash contents of wara produced from sheep milk. The results shows that the moisture and fat contents of wara produced with steep water from maize had the highest value of (60.52 and 18.23) respectively, the ash content of wara produced with *Calotropis procera* had the highest value (0.83), the protein and carbohydrate contents of wara produced with steep water from sorghum had the highest values of (32.67 and 10.45) respectively. This study suggests the use of steep water from grains such as maize millet and sorghum as an alternative milk coagulant due to reports of probable health hazard from the use of *Calotropis procera*. However, further work on improving the yield of cheese when this steep water is used as coagulant is still necessary.

Keywords: Proximate Composition, Sheep Milk, Steep Water, Wara

1. Introduction

Milk is an essential part of daily diet for the growing children and expectant mothers. Milk is a major constituent of the diet, its quality assurance is considered essential to the welfare of a community (Marimuthu *et al*., 2013).

The principal constituents of milk include fat, protein, total solid, lactose and ash. In addition to this, milk contains several hundred minor constituents many of which includes milk fat, vitamins, metal ion and flavor compounds, which have a major impact on the nutritional, technological and sensory properties of milk and dairy products (Armstrong, 1995).

In recent development, it has been observed that milk coagulants of plant origin have over-ridden the use of animal rennet. The reason being that animal rennet may be limited for diet (vegetarianism), religious reasons (Judaism and Islam), or being genetically engineer food, of which the Germans and the Dutch for example, forbid the use of recombinant calf rennet (Roseiro *et al*., 2003).

In Nigeria, milk production is mainly done by the Fulani nomadic people who are pastoralists involved in the rearing of cattle 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, unripened cheese called “warankasi” or “wara” in short term (Adetunji and Babalobi, 2011).

Wara is an excellent source of protein, fats and minerals such as calcium, iron and phosphorus, vitamins and essential amino acids, thus making it an important food in the diet of both old and young (Oladipo and Jadesimi, 2013).

Calotropis procera (Sodom apple) extract has been used for wara production since ancient time especially in West Africa (Aworth and Muller, 1987). The use of *Carica papaya*

and Lemon juice for wara production has also been reported by some researchers. (Akinloye and Adewumi 2014, Adetunji *et al*., 2008). Although investigation has revealed that coagulants of plant origin have some inherent drawback which limits their use. For example the mealy texture white cheese made with extract from *Carica papaya* showed flavor defect such as bitterness. Nevertheless despite these drawbacks, experiment has also shown production of better cheese with vegetable coagulants (Adetunji and Salawu, 2008).

The use of Steep water from maize (which is considered to be of no value) for the production of Tofu (a coagulated soybean milk) have been reported by several researchers (Oboh and omotosho, 2005, shokunbi *et al*., 2011, Yakub and Amuzat 2012). However few works have been done on the use of steep water for the production of wara. (Badmos and Joseph., 2012)

Also, Although a lot of findings have been done on the production of local cheese (wara) from cow milk (Ojedapo *et al.,* 2014, Belewu, 2006; Adetunji *et al*, 2008; Akinloye and Adewumi 2014, Sangoyomi *et al*., 2010), but few work have been documented on the use of other animal milk such as sheep, goat, camel e.t.c (Asif and Sumaira 2010, Elbagermi *et al* 2014) along with different coagulants. Goat milk differs from cow or human milk in having better digestibility, alkalinity and buffering capacity (Park, 1994). Sheep milk is an excellent raw material for the milk processing industry especially in cheese production (Park *et al*., 2007). Sheep milk has higher specific gravity, viscosity, refractive index, titratable acidity, and lower freezing point than average cow milk (Haenlein and Wendorff, 2006).

Therefore the thrust of this study is to evaluate the percentage yield and proximate composition of wara produced with different animal milk using different coagulants.

2. Materials and Method

Sample collection: The raw milk sample was collected from sheep, at the Fulani pastoralists at a local farm settlement, Ado Ekiti. It was collected aseptically and transported to the laboratory for analysis.

Plant collection: The leaves (*Carica papaya* and *Calotropis procera)* were collected from The Federal Polytechnic, Ado-Ekiti.

Collection of coagulants: Lemon fruits used were purchased from the market and steep water (effluent from pap produced from maize, sorghum, millet) were produced by steeping the grains in water for 3days after which it was milled and later steeped again for 2days. The steep water was then collected for use as coagulants.

2.1. Production of Wara

The milk was stirred gently during the heating process with a wooden spoon. About 4ml of the leaf extract of *Calotropis procera, Carica papaya,* Lemon juice and steep water were added to the warm milk and the mixture was heated the second time with intermittent stirring to about 45-50°C and was kept at this temperature until coagulation was achieved and the heating was stopped after the separation of curd and whey. The sign of coagulation was observed within the range of 10-15 min. It was transferred into a small rafia basket to facilitate whey drainage and characteristic shape, when the wara was firm enough it was removed from the raffia basket and placed inside a covered plastic container for analysis.

2.2. Proximate Analysis of Cheese Sample

Determination of ash content: 5 g of the cheese sample was weighed into porcelain crucible previously ignited and weighed. The material was ignited in the fume cupboard until no fume was seen charred of organic matter. This was transferred into muffle furnace at 550 C using a pair of tongs and was ignited for 3 hours, cooled in a desiccator and weighed immediately.

2.3. Determination of Fat Content by Soxhlet Extraction Method

5 g of cheese sample was weighed and put in thimbles using a dry paper and plugged with cotton wool. The thimbles were dried and inserted into a soxtec system HT2. The extraction cups were dried and weighed and 50 ml solvent (petroleum ether) was added in each cup. The cups were inserted into the soxtec. The samples were extracted for 15 min in boiling position. The extraction was carried out continuously for 3 hours. This was cooled and reweighed.

2.4. Determination of Protein Content of Cheese

Kjedahl nitrogen method was employed for the determination of protein content of the cheese. 1.0 g of the cheese sample was weighed into the digestion flask. Kjedahl catalyst (5 selenium tablets) was added to the sample. 20 ml of concentrated tetraoxosulphate (VI) acid was added to sample and fixed for 8 hours in the digestion unit (45°C) of the Kjedahl apparatus in fume cupboard. The digest, pure yellow after cooling changed into a colourless liquid that was transferred into 100 ml volumetric flask and made up to mark with distilled water. 20 ml of 4% boric acid solution was pipetted into conical flask. A drop of methyl red was added to the flask as indicator. The sample was thereafter diluted with 75 ml of distilled water. 10 ml of the digest was made alkaline with 20 ml of NoaH (20%) and distilled. The steam exit of the distillatory was closed and the change of colour of boric acid solution to green was timed. The mixture was distilled for 15 min (AOAC, 2012). The filtrate was titrated against 0.1 N HCl. The protein content was calculated from the relationship:

Total protein (%) Titre x Normality of acid x 0.014/ Sample weight x 10

Protein conversion factor = 6.38 for Milk

Protein (%) = % Nitrogen x 6.38

Normality of acid (HCl) = 0.1 N

Sample weight = 1.0 g

2.5. Determination of the Carbohydrate Content of Cheese

This was determined by subtracting from 100 the sum of the percentage moisture, ash, protein and fat. The remainder value gives the carbohydrate content of the sample.

Carbohydrate (%) = 100-(sum of moisture, protein, ash and fat)

2.6. Determination of Yield

The quantity of cheese produced from each experiment was weighed with electric weighing scale and recoded as yield. Yield percentage was calculated as shown in the Table below. The experiment was carried out thrice and the mean calculated.

% of cheese yield = grams of cheese produced/ grams of milk used X 100

2.7. Statistical Analysis

The statistical analysis was carried out using SPSS program (Statistical Package for social Sciences version 16). The significant difference between means was calculated by one-way Analysis Variance (ANOVA) using Duncan multiple range test (DMRT) ($p \leq 0.05$).

3. Results

Table 1. *The proximate composition of wara produced from sheep milk using different coagulants was carried out.*

Sample	Moisture	Ash	Protein	Fat	CHO
SSO	53.20± 0.05e	0.48±0.02c	32.67±0.02a	12.02±0.03e	10.45±0.02a
SMA	60.52±0.00a	0.42±0.02d	29.87±0.03b	18.23±0.02a	
SMI	58.46±0.05b	0.46±0.06cd	24.20±0.01d	18.21±0.00a	5.52±0.61c
SLJ	57.81±0.01c	0.53±0.00c	27.38±0.51c	13.20±0.02d	4.00±0.00e
SCPR	54.95±0.04d	0.83±0.02a	20.54±0.04f	13.25±0.00c	4.20±0.07d
SCP	52.34±0.01f	0.66±0.00b	22.06±0.04e	15.73±0.02b	3.26±0.04f

Table 2. *Proximate analysis of raw milk.*

Types of milk	Moisture	Ash	Protein	Fat	Carbohydrate
Sheep	87.19±0.06b	0.83±0.02a	8.06±0.01a	2.81±0.01a	1.11±0.01c

Table 3. *Percentage yield for sheep milk coagulated with different coagulants.*

SAMPLE	% YIELD
SSO	5.00
SMA	3.80
SMI	5.50
SLJ	18.20
SCPR	25.60
SCP	19.36

4. Discussion

Wara is an African soft cheese produced from animal milk such as cow, sheep, goat, and camel. It can be coagulated with different coagulants among which is the commonly used *Calotropis procera*, *Carica papaya* e.t.c.

Table 1 shows the result of proximate composition of wara produced from sheep milk using different coagulants. The moisture content of wara produced with steep water from maize has the highest value of 60.52. The result obtained is similar to those reported by Aworh and Akinniyi (1989) and Fasakin and Unokiwedi (1992) who obtained 61.3% and 60.8% respectively. Higher moisture content could favour the growth and proliferation of microorganisms as reported by (Adegoke *et al*., 1992) thus reduces the shelf-life of cheese. However, Egan *et al*. (1981) and Frazier and Westhoff (1988) had stressed that the moisture content is a measure of the water content and accounts for the texture of the cheese. The highest fat content was also observed in milk coagulated with steep water from maize (18.23). Hannon *et al*., 2006 reported that fat is important as a source of energy to the body. The highest ash content obtained from wara coagulated with *Calotropis procera* which is 0.83% is also similar to those obtained by Aworh and Akinniyi (1989) in which they obtained a value of 0.8%. The protein content of wara produced with steep water from sorghum has the highest values of 32.67. The protein values discovered in this study were higher than those reported by earlier researchers on cheese and these values are 5.33% (Frazier and Westhoff, 1988) and 12.86% (Uaboi-Egbenni *et al*., 2010), but lower than the findings of Fashakin and Unokiwedi (1992) who reported 44.5% protein of cheese with added melon milk. This variation in high protein content of the samples in this study may be attributed to protein content in the cereals might have migrated into the wara sample. The high protein content of this product shows that its consumption will help eliminate protein deficiencies in Nigeria. Steep water from sorghum coagulated milk has the highest carbohydrate value of 10.45. This is higher than the result obtained by Uaboi-Egbenni *et al*., 2010 who reported 9.14% carbohydrate during the proximate analysis of cheese produced from raw cow milk.

Table 2: shows the result of proximate analysis of raw sheep milk. It was observed that the moisture content of the raw milk which is 87.19 was higher than the wara produced; however, the carbohydrate content, the ash content, protein content and the fat contents were all lower than those obtained in the wara produced with the different coagulats. This may be due to the fact that the physico-chemical properties such as carbohydrate, ash, protein and fat are

increased by the addition of the coagulants used however, the moisture content which was reduced might be due to the heat applied during wara processing.

Table 3 shows the result of percentage yield of sheep milk coagulated with different coagulants. *Calotropis procera* gave the highest percentage yield of 25.60 followed by *Carica papaya* (19.36), lemon juice coagulated milk has 18.20 percentage yield. However, among the steep water of the three cereals used, millet steep water gave the highest cheese yield of 5.50 compared with sorghum and maize steep water with 5.00 and 3.80 respectively. This is similar to the work of (Badmos and Joseph 2014) which gave the highest yield for millet steep water, there is a general trend of high percentage yield with millet and millet based diets compared with maize and sorghum steep water. The low yield observed in the wara produced with the steep water from the cereals implied that steep water coagulated cheese might not be a good source for profit making. The highest cheese yield obtained from wara produced with *Calotropis procera* shows that *Calotropis procera* has the highest coagulating capacity followed by *Carica papaya*. Lemon juice also coagulates well and the result obtained indicates that it can compete favourably well with *Calotropis procera* and *Carica papaya* in terms of cheese yield.

The result obtained in this study is similar to the findings of Akinloye and Adewumi, 2014 who observed the same trend in the percentage cheese yield of *Calotropis procera, Carica papaya* and *Lemon juice* respectively (28.01, 26.91, 20.92) in the same order.

5. Conclusion

It is quite evident from this study that sheep milk can also be used for the production of wara of high quality. Apart from the commonly used *Calotropis procera*, other coagulants such as Lemon Juice and steep water from cereals can also be used for the production of wara.

The result of the proximate analysis reveals that steep water coagulated wara is of high quality although there is need for improvement on the yield of the product.

References

[1] AOAC (2012) Official Methods of Analysis 20th Edition Association of Analytical Chemists Washington D.C. 46-80.

[2] Adegoke, G. O., Nse, E. N. and Akanni, O. O. (1992), "Effects of heat, processing time and pH on the micro- flora, aflatoxin content and storability of 'wara', a soft white cheese", Die Nahrung, Vol. 36, pp. 259 – 264.

[3] Akinloye A. M and Adewumi O. O (2014). Effects of local coagulants on the yield of cheese using cow and sheep milk, *International. Journal of Development and Sustainability* 3 (1), 150-161.

[4] Adetunji, V. O. and Salawu, O. T. (2008), "West African soft cheese 'wara' processed with *Calotropis procera* and *Carica papaya*: A comparative assessment of nutritional values, *International Journal of Dairy Science,* Vol. 6 No. 1, pp. 58 – 65.

[5] Adetunji VO, Alonge DO, Singh RK and J Chen (2008) Production of wara, a West African soft cheese using lemon juice as a coagulant. Journal of Food Science and Technology. 41: 331–336.

[6] Armstrong, H. C; (1995). Food and nutrition Pp 20 London.

[7] Asif Mahmood and Sumaira Usman (2010). A Comparative Study on the Physicochemical Parameters of Milk Samples Collected from Buffalo, Cow, Goat and Sheep of Gujrat, Pakistan. *Pakistan Journal of Nutrition* 9 (12): 1192- 1197.

[8] Aworh, S. and A. Akinniyi, 1989. Proximate analysis and nutritional component of locally produced cheese. Nigerian Journal of Food Science and Technology., 9: 220-227.

[9] Aworth O C and Muller H G (1987) Cheese-making properties of vegetable rennet from sodom apple (*Calotropis procera*). Food Chemistry 26 71–79.

[10] Egan, H., R. S. Kirk and R. Sawyer, 1988. Pearson's Chemical Analysis of Foods. Bath. Aron., pp: 15-20.

[11] Elbagermi, M. A Alajtal A. I, Edwards, H. G. M. (2014). A Comparative Study on the Physicochemical Parameters and Trace Elements in Raw Milk Samples Collected from Misurata- Libya. Sop Transactions on Analytical Chemistry. Volume 1, Number 2.15-24.

[12] Fasakin, A. and C. Unokiwedi, 1992. Chemical analysis of fermented cheese obtained from Cow milk and melon. Nigerian Journal of Microbiology., 5: 559-566.

[13] Frazier WC, Westhoff DC (1998). Food Microbiology. 4th ed. Tata McGraw Hill Publishing Ltd., New Delhi, pp. 276-297.

[14] Haenlein, G. F. W. and W. L. Wendorff, (2006). Sheep milkproduction and utilization of sheep milk. In: Park, Y. W. and G. F. W. Haenlein, (Eds.), Handbook of Milk of Non-Bovine Mammals. Blackwell Publishing Professional, Oxford, UK and Ames, Iowa, USA, pp: 137-194.

[15] Marimuthu M, Sankar N, Sathish A, Vivek S and Mohan Raj N. (2013). Comparative study on Physicochemical quality of raw milk samples collected from different villages of Karur district Tamilnadu, India. *International Journal of Pharmaceutical, Chemical and Biological sciences.* 3 (3), 635-638.

[16] Oboh G, Omotosho OE (2005): Effect of coagulants on the nutritional quality and In vitro multienzyme protein digestibility of Tofu. Journal of Food Technology. 3 (2): 182 – 187.

[17] Ojedapo L. O, Tona G. O, Amao S. R and Adeneye J. A. Yield, composition and coagulation time of unsalted and salted soft cheese prepared from the milk of White Fulani cow. *International Journal of current Microbiology and Applied sciences.* Vol. 3 (8). pp. 378-383.

[18] Park, Y. W., M. Juarez, M. Ramosc and G. F. W. Haenlein.(2007). Physico-chemical characteristics of goat and sheep milk. Small Rumin. Res., 68: 88-113.

[19] Park, Y. W., (1994). Hypo-allergenic and therapeutic significance of goat milk. Small Rumin. Res., 14: 151-161.

[20] Roseiro, L. B., Barbosa, M., Ames, J. M. and Wilbey, R. A. (2003), "Cheese making with vegetable coagulants – the use of Cynara L. for the production of ovine milk cheeses", *International Journal of Dairy Technology*, Vol. 56 No. 2, pp. 76 - 85.

[21] Sangoyomi, T. E., Owoseni A. A. and Okerokun, O. (2010). Prevalence of enteropathogenic and Lactic Acid Bacteria species in wara. A local cheese from *Nigeria African journal of microbiology research* vol. 4 (15), pp. 1624-1630.

[22] Shokumbi, O. S., O. O. Babajide, D. O. Otaigbe and G. O. Tayo, 2011. Effect of coagulants on the yield nutrient and anti-nutrient composition of tofu. *Archives of Applied Science Research,* 3 (3): 522-527.

[23] Uaboi – Egbmni, P. O, P. N. Okolie, T. L. Akintunde, O., Bisi – Johnson, L. Enwe, N. and P. O. Bessong. (2010). Pakistian Journal of nutrition 9 (9): 920-25, ISSN 1680- 5194@Asian network for scientific information. U.S Department of Agriculture (USDA) USDA: APHIS: US: CEAH, 2005. NRRC Building B, M. S 2E7 2150 Centre Avenue fort Collins, Co 80526-8117 970.494.7000.

[24] Yakubu Ndatsu and Amuzat Aliyu Olekan. (2012) Effects of Different Types of Coagulants on the Nutritional Quality Tofu Produced in the Northern Part of Nigeria. *World Journal of Dairy & Food Sciences* 7 (2): 135-141.