Nigerian J. Anim. Sci. 2017 (2):33 - 38

Physicochemical, microbial and sensory properties of milk, butter and garlic butter

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Target Audience: Animal Scientist, Dairy Industry, Dairy Researchers

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Abstract

A study on the physicochemical, microbial load and sensory properties of milk, butter with or without garlic was carried out using fresh milk from white Fulani cow for eight weeks of the lactation. The milk used was milked manually by the Fulanis early in the morning. Fat content was highest in milk (4.13±0.16) and least in garlic butter (2.50±0.46). There was no observed significant (P>0.05) difference in the protein, lactose, total solid, ash and pH of the milk, butter and garlic butter. Lactose content of the products differs with milk having highest (2.82%) while butter had the least (1.26%). Fat content in milk, butter and garlic butter varies in value from 4.13%, 3.25% and 2.50% respectively. Total solid obtained in this study was 9.22% for milk, butter 8.21% and garlic butter 7.69%. Ash content of milk and butter were 0.72% and 0.64% respectively. Garlic had a significant effect on all the microorganisms present in the butter. The taste panel ratings for butter and garlic butter shows that the taste, aroma, flavour and acceptability of ordinary butter were more preferred by the panellist.

Keywords: Physicochemical, Microbial, Sensory, Milk, Butter, Garlic butter

Description of Problems

Butter is dairy product made by churning fresh or fermented cream or milk. It is generally used as a spread and a condiment, as well as in cooking, such as baking, sauce making and pan frying. Butter consists of butterfat, milk protein and water. It is most frequently made from cow's milk; butter can also be manufactured from the milk of other mammals, including sheep, goats, buffalo and yaks. Salt, flavouring and preservatives are sometimes added to butter. Butter is a water-in-oil emulsion resulting from an inversion of the cream, oil-in- water emulsion; the milk proteins are the emulsifier. Butter remains a solid when refrigerated, but soften to a spreadable consistency at room temperature and melt to a thin liquid constituent at 32-35^{0}C (90-95^0 F). [1].

Garlic, known botanically as *Allium sativum*, is a widely distributed common plant. It is used in all part of the world not only as spice and food, but also as a popular folk remedy for a variety of ailments. Therefore, the objective of this work was to determine the physicochemical, microbial and sensory properties of milk, butter and garlic butter.

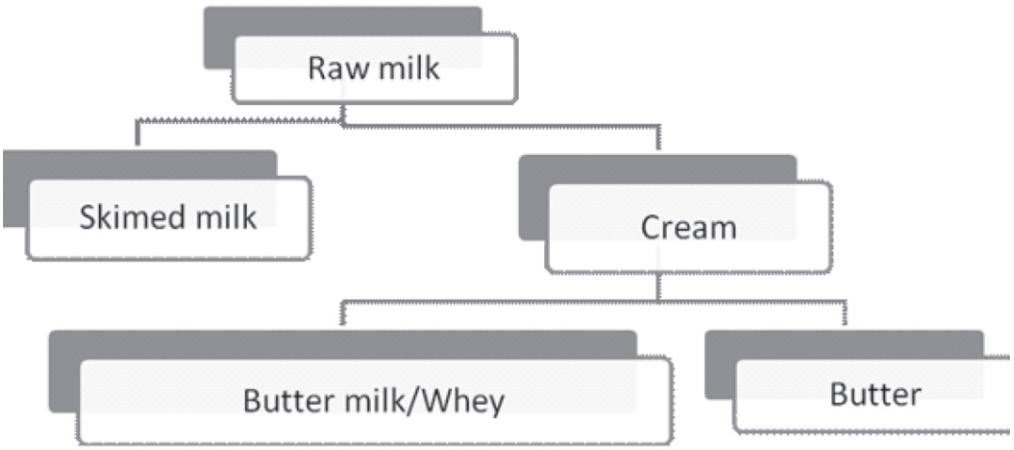
Materials and methods

The milk was collected from the Fulani cattle rearers in Alabata village in Abeokuta, Ogun State, Nigeria. The animals used for the research were managed under extensive management system, whereby the animals were allowed to graze on available forage in their environment and travelling far in search for forage during the scarce time. Milk was collected for five weeks from cattle. Milking was done manually by the Fulani. The milk yield of the cow measured was between the ranges of 1450-1675g (Table 1), the milk was covered immediately to avoid contamination. The cow were at second parity, between 6-7years and the cows weight was about 357kg

Butter making:

The milk was placed in a clear container for 2 days (48hrs) in the refrigerator when someone can easily see a distinct cream line on the top. Dipper was used to skim the cream off the top. (Cream that is not fresh, up to a week, produces butter more quickly). Cream was set out on the counter for 1hour 30 minutes, until it reaches room temperature. The cream was placed in a clear glass container. The cream was churned (vigorous shaking) for 15 minutes when the butter has been formed. The buttermilk was poured and the butter was dumped into another bowl. The butter was formed into a ball and washed with fresh cold water, by kneading it or, getting small amount of water and doing it repeatedly till the water is clear. The butter was pressed firmly into a container. Refrigerate or freeze for proper storage.

Flow chart in making butter



Steps in making garlic butter

The butter block was melted. It was mixed in bowl with electric mixer on low for about 1 or 2 minutes. Garlic extract was added. The mixture was put into the food processor or mix with electric mixer on high for about 30-45 seconds. The mixture was put in a container (with lid) or bowl (put cling wrap on bowl). And the butter was placed inside the fridge until butter was formed [2].

The milk samples were analyzed for protein, fat, total solids and ash using standard methods [3].

Analytical procedure of pH of milk and butter

The pH value of milk and butter was determined by using a digital pH meter [4]. Prior to use, the pH meter was standardized with standard buffer solution of pH 4 and 7.

Analytical procedure of microbial load of milk and butter

Bacteria count: This was estimated according to [5] by diluting 10ml of the butter sample in 90ml of sterile water to make 1:10 dilution. Each 1ml of the diluted butter was spread on Nutrient agar which was used to estimate for total viable bacteria count, MacConkey agar was used to plate for coliform count, and Mannitol salt agar was used to plate for *Staphylococcus spp.* All the agar plates were incubated at 37^0C for 48hours and each bacteria isolated was estimated accordingly.

Total yeast and mould count: This was estimated according to (6) by diluting 10ml of the butter sample in 90ml of sterile water to make 1:10 dilution. Each 1ml of the diluted butter was spread on Acidified Potato Dextrose agar and incubated at room temperature for 7days. Each suspected yeast and mould isolates was estimated accordingly.

Sensory evaluation of butter

10 man panellists were given hedonic scale to test, for taste, texture, colour, flavour, odour and overall acceptability of coded samples of cow milk butter as a control and cow milk garlic butter. They graded using a five point score system on a scale of 1-5 (1 = excellent, 2 = very good, 3 = good, 4 = fair and 5 = poor) as described by [7].

Statistical Analysis Statistical analysis of the data obtained was subjected to the analysis of variance (ANOVA) of the SPSS package [8]. Means with a significant difference was compared by Duncan's multiple range tests and T test analysis.

Result and Discussion

Fat content was highest in milk (4.13±0.16) and least in garlic butter (2.50±0.46). However, there was no observed significant ($P>0.05$) difference in the protein, lactose, total solid, ash and pH of the milk, butter and garlic butter (Table 2). The protein content of butter was highest (3.06%), followed by garlic butter (2.70%) and least in milk (1.54%). This was at variance with [9] which reported that the crude protein of garlic increase the quality of the dairy product. The higher protein content of butter compared to that in milk could be attributed to the presence of bacterial that was present in the cream that was used in making the butter; the cream was left for 90-120minutes which might have resulted in build-up of bacteria before it was churn into butter. Lactose content of the products differs with milk having highest (2.82%) while butter had the

Table 1 Weekly yield of milk, cream, butter and whey/buttermilk in grams

Milk yield (g)	Skim milk (g)	Cream(g)	Butter (g)	Garlic butter (g)	whey/buttermilk (g)
1450	1239	211	51	49	111
1600	1330	270	60	50	160
1400	1201	199	51	45	103
1680	1360	320	70	60	190
1675	1375	300	62	56	182
1561 ± 57.84	1301.0 ± 34.38	260 ± 23.89	58.80± 3.59	52.0 ± 2.66	149.20 ± 17.95

Table 2: The physicochemical properties of milk, butter and garlic butter

Parameters	Milk	Butter	Garlic butter
Protein	1.54±0.09	3.06±0.61	2.70±0.64
Lactose	2.82±0.65	1.26±0.30	2.09±0.48
Fat	4.13±0.61^{a}	3.25±0.38^{ab}	2.50±0.46^{b}
Ash	0.72±0.16	0.64±0.25	0.40±0.20
pH	7.01±0.22	6.01±0.14	5.85±0.21
Total solid	9.22±1.01	8.21±0.85	7.69±0.75

Table 3: Effect of microbial load count on milk, butter and garlic butter ($\times 10^{11}$)

Parameter	Milk	Butter	Garlic butter
Coliform count	15.20±5.15^{a}	5.42±1.79^{ab}	2.86±1.36^{b}
TVBC	51.64±15.88	27.18±12.06	15.94±7.37
SS	1.74±1.29	2.30±2.30	0.40±0.40
Yeast and mould	16.78±8.91	9.22±2.45	2.68±1.20

^{a,b} Means with the same letter are not significantly different. SEM=standard error mean
TVBC- Total viable bacterial count. SS –Staphylococcus species

least (1.26%). The reduced lactose content in butter could be due to incubation time [10]. Motaghi *et al.*[10] reported that the reduction in sugar content of kefir was observed as a result of a function of incubation time. It could also be attributed to the heat applied to the cream that was used before turning it to butter. Fat content in milk, butter and garlic butter varies in value from 4.13%, 3.25% and 2.50% respectively. The fat content of milk recorded in this study falls within the range of 3.5-6.0% which is the ideal fat content of milk. However, the fat content of milk in this study was slightly higher than that reported by [11] who recorded fat content of 3.11% for cow's milk. This research showed that fat content of milk is 4.13% which is within the range reported by [12] who reported fat content of 4.6% in milk. The processing of dairy product industrially has also been reported to result in reduction of fat content [13]. Total solid obtained in this study was 9.22% for milk, butter 8.21% and garlic butter 7.69% which are very close to what was reported by [12] who recorded total solid of 8.5%. Ash content of milk and butter were 0.72% and 0.64% respectively. The ash content of milk was higher to that reported by (14) who reported ash content of 0.6% in milk. pH of the product reduces from milk, butter to garlic butter with values of 7.01%, 6.01%, 5.85% respectively. pH reduces

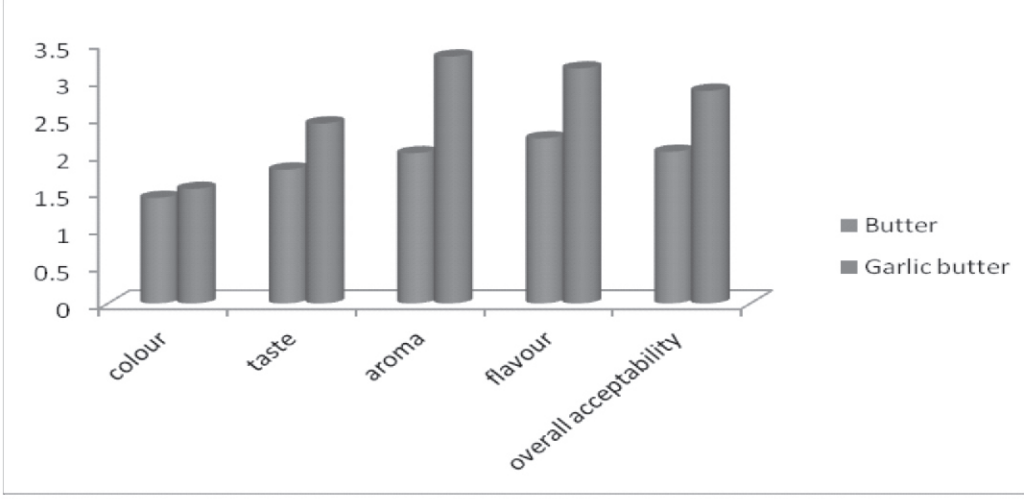


Figure 1: Sensory Characteristics of Butter and Garlic Butter

due to increase in lactic acid which causes the milk to clog in churning of butter. Belewu *et al.*11] reported the pH of milk to be 6.5% which is close to that obtained in this study.

In the entire microbial load results obtained, all values were represented in colony forming unit ($\times 10^{11}$ cfu/ml). From the result obtained, it showed that garlic have a significant effect on all the microorganisms present in the butter. Actually, the milk was preserved in refrigerator to separate the cream from milk that was used for butter production; the freezing of milk may slow down the activities of microorganism but not on all classes, because some organisms survive under process of cooling. From the result, it was observed that application of garlic to the butter makes the amount of microorganism present in the butter to reduce drastically. This corroborate the report of [15] that an aqueous extract of freeze dried garlic (*Allium sativum*) inhibit many representative bacterial, yeast, fungi and viruses.

Figure 1 shows the effect of butter and garlic butter on sensory characteristic. The taste panel ratings for butter and garlic butter shows that the taste, aroma, flavour and acceptability of ordinary butter was more preferred by the panellist. The preference of butter could be attributed to the desirable colour, taste, aroma and flavour of the ordinary butter

Conclusion and Application

The result obtained in this study showed that

1. Fat content was highest in milk while it was least in garlic butter
2. Protein was higher in butter compared to garlic butter while the pH was lowest in garlic butter
3. The microbial load in butter was higher to that obtained in garlic butter.

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