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BACTERIAL EVALUATION AND PASTEURIZATION OF MILK FROM TRADITIONALLY RAISED WEST AFRICAN DWARF (WAD) GOATS IN RIVERS STATE

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Target Audience: Animal nutritionists, veterinary, food and dairy scientists.

ABSTRACT

Six West African Dwarf goats in their late pregnancies were purchased locally and reared at the Teaching and Research Farm of the Rivers State University of Science and Technology, where they later kidded. They were hand-milked and their milk pasteurized by the local method of heating over firewood. The bacterial quality of the milk was evaluated before and after pasteurization by plate count, gram stain, cultural characteristics and biochemical reaction. Lactobacilli, Staphylococci, E coli and Proteus sp were identified. The bacterial load after local pasteurization was 28.5% times lower than in the initial raw milk and 15% times lower than the usual load acceptable for conventional milk The local method of pasteurization is therefore both easy and safe for human consumption, in areas where standard facilities are not available.

Key words: Goat, Milk, Pasteurization, Bacteria

DESCRIPTION OF PROBLEM

The West African Dwarf (WAD) goat is a traditional household livestock in West Africa. Most rural families in Southern Nigeria own between 1-20 heads (1). By this token, these families should derive the better proportion of their protein from the more regular goat milk than from goat meat (chevon) got from the occasional slaughter of goat. Goat milk is a very good source of protein and could be used by peasant families whose animal protein intake is very low. The human body needs protein regularly in dynamic quality and quantity, otherwise deficiency syndromes become manifest, ultimately as `Kwashiorkor' particularly in children.

Goat milk may sooner or later become more popular than cow milk for some obvious reasons: goats are owned by nearly all household units, while cow milk is out of reach to many people; the climate of West Africa is favourable to

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WAD goat husbandry (2); goat milk is not apt to curdle in the stomach like cow milk (3,4,5) and it has fewer pathogens than cow milk (5,6).

With the above knowledge in view it is now exigent to evaluate the bacterial status of WAD goat milk and provide a local technique for pasteurization to make it wholesome for consumption. It should be borne in mind that the milk gets contaminated during milking, through atmospheric dust, coat/hair of goat, milker's hand, utensils, feed, water, soil (6) and in mastitis (7). Hence bacterial evaluation and pasteurization of WAD goat milk becomes very important.

Following this study, peasant farmers would like to milk their goats, shun the taboos (8) against goat milk and consume it. For this reason the objective of the study was to assess the bacterial status of the WAD goat milk and pasteurize it by local techniques that could be easily handled by the local peasant families.

MATERIALS AND METHOD

Six WAD goats reared under traditional free range system in Chokocho village near Port Harcourt, were procured in their late pregnancies and taken to the Teaching and Research Farm (TRF) of the Rivers State University of Science and Technology, for bacterial evaluation and pasteurization of their milk during the period of six weeks in lactation. The does were aged between two and three years (teeth estimation) and weighed 25kg on average.

The experimental goats were confined in a building in TRF and zero fed with browse and forage till all of them kidded within a gap of 15 days. Milking parlours were prepared in a portion of the building where they were tethered to pegs for restraint. The kids were allowed to suckle their mothers for six days before milk evaluation started. Thereafter, they were separated from their mothers at night and returned to them the next morning after milking the does. Each morning, the parlour was cleaned, disinfected and the floor covered with a clean water-proof mackintosh. All milking utensils were disinfected and kept handy. Fresh towels were used for every goat. Milker's hands were frequently rinsed in warm soapy water. Before milking, the udders were washed clean with warm detergent water and rinsed with clean warm water. Thereafter an assistant lifted the two forelegs off the ground, thus obliging the goat to stand on the two hind legs. The milker then milked the goat from a posterior approach, with both hands moving simultaneously on both teats. The first squirt of milk was always discarded. Daily collections from all the goats were bulked together, from which samples were taken before and after pasteurization for bacterial analysis. Analysis for the identification of bacteria involved total viable count (TVC), observation of cultural characteristics on Nutrient Agar (NA), MacConkey Agar and Mannitol Agar, Gram reaction and biochemical tests.

Pasteurization was effected by heating the milk in an aluminium bowl placed in a boiling pot of water on a tripod stand over firewood. Prior to heating, the

fresh milk was filtered through a clean calico cotton fabric. While over fire, the milk was stirred. Just as it was about to boil the pot was tightly covered with the lid and the firewood dispersed to stop the fire. The pot was then left to cool on the tripod for 30-60 minutes in order to allow more heat to penetrate in the milk.

For the total viable count (TVC), serially diluted milk samples were plated in duplicate in petri dishes of the various media and incubated at 37°C for 24-72h. Discrete colonies were counted from selected plates and averaged for the duplicated plate of each medium. Daily counts were averaged at the end of the week and the final mean computed at the end of the sixth week of lactation. Three sets of viable counts were obtained for the three media in the 2nd, 4th and 6th weeks from which the cumulative mean was also computed.

Cultural characteristics of the bacterial growths on the various media were studied by gross visual observation. The discrete colonies were subcultured and subjected to Gram stain and some biochemical tests which included Methyl Red (MR), Voges Prausker (VP), Citrate Utilization, indole production, motility, urease reaction, gas production, H_2S production and Acid/Alkaline reaction.

RESULTS AND DISCUSSION

In Table 1, the organisms identified by cultural characteristics and Gram stain reaction were: *Lactobacilli* on Rogosa plate consisting of tiny dry colonies and stained Gram positive rods; the Coliforms on MaConkey plate were moist, dome-shaped, tiny reddish colonies and stained Gram positive rods; *Staphylococcus albus* on Mannitol plates were white moist colonies and Gram negative *cocci* and *Proteus sp* on nutrient agar were swarming whitish colonies emiting ammoniacal odour and stained Gram negative rods. The overall mean total viable count for raw milk from the three media was 6222 cfu/ml whereas the mean count for locally pasteurized milk was 193 cfu/ml, thereby reducing bacterial population by 96.9% (Table I).

Table 1: Total Viable Count

Type of media	Count before pasteurization	Count Local	After Pasteurization % Reduction
Nutrient Agar	6800	192	97.2%
MaConkey Agar	5980	199	96.7%
Rogosa Agar	5886	190	96.8%
Mean	6222 ± 38.1	193 ± 1.18	96.9%

The Biochemical reactions were exhibited (Table 2) as follows: *Lactobacillus sp* was positive for MR, acid butt and alkaline slope; *E coil* was positive for MR, indole, motility gas, acid butt and alkaline slopes; *Staphylococcus sp* was positive for VP, citrate, acid butt and alkaline slope and *Proteus sp* was positive for MR, indole motility, urease, gas, H_2S, acid butt and alkaline slope.

Table 2: Cultural, Biochemical and Structural Characteristics of Bacterial Isolates

Isolate / Plate	Plate culture characteristic	Gram	MR	VP	Citrate utilization	Indole production	Motility	Urease	Gas	H_2S	Butt	Slope	Structure
S. Albus Mannitol	White,entirely moist	+ve	-	+	+	-	-	-	-	-	Acid	Alkaline	Cocci
E.Coli/MaConkey	Tiny reddome shaped	-ve	+	-	-	+	+	-	+	-	Alkaline	Acid	Bacilli
Proteus. sp/nutrient Agar	Swarming ammoniacal odour	-ve	+	-	-	-	+	+	+	+	Acid	Alkaline	Bacilli
Lactobacilli sp/Rogosa	Tiny, dry	+ve	+	-	-	-	-	-	-	-	Acid	Alkaline	

MR - Methyl red
VP - Voges Prauskeur

The main purpose of this study was to render milk from WAD goat wholesome for consumption. In doing this, the easiest method was direct heating using local utensils and firewood, coupled with manipulation of the heat to bring about the elimination of potential pathogenic organisms, while simultaneously retaining the nutritive quality of the milk.

Conventional pasteurization uses either of the two methods - Low Temperature Holding (LTH) method (145F or 62.8°C for 3 min) or High Temperature Short Time (HTST) method (161F or 71.7°C for 15 seconds). In order to achieve a similar result with the local method, heating the milk to near boiling point (BP) was adopted. By this, the time it took the temperature to rise from 71.7°C to about 95°C (a difference of 23.3°C) was sufficient to achieve even a better effect than keeping the temperature at 71.7C for 15 seconds, with respect to destroying microorganisms. This was established by the fact that bacterial count was much more reduced after pasteurization by the local method than the two conventional methods listed above.

By the recommendations of the US Public Health Service, Washington DC 1967, (9) grade A raw milk for pasteurization should not exceed 100,000 bacteria/ml, while grade A pasteurized milk and milk products should not be more than 20,000 bacteria/ml. This means that the final bacterial load after pasteurization should be five times lower than the raw milk, giving a 20% count reduction. The initial load in the raw WAD goat milk was 6222 ± 38.1 which is about half the load of raw cow milk (9). This count was reduced after local pasteurization to 193.67 ± 1.8 cfu/ml (Table 1) being 32.12 times lower than the raw milk or 96.9% reduction, as against the conventional method. The level of bacterial reduction by the local pasteurization is also 103 times less than the conventionally accepted level. This makes it highly safe from pathogenic organisms. Except for other factors such as protein content which might suffer a negligible adverse effect under local pasteurization, it renders milk much safer from the risk of pathogenic organisms than the conventional methods. Post pasteurization composition of milk (10) showed that protein value was very slightly affected by the heat treatment, while fat had minimal loss, and vitamin C suffered the most, although milk is not a notable source of this vitamin. Similar observations were seen in an earlier part of this study where protein value remained almost the same after local pasteurization.

CONCLUSION AND APPLICATIONS

1. Milk obtained from village goats can be locally pasteurized, so that the village dwellers can consume it with minimal risks of bacterial infection.
2. The method of pasteurization described is simple and can be easily handled by the peasant farmers.

3. Consequently, local pasteurization will give confidence to consumers, enhance goat milk production and cause reduction in the cost of milk, while the nutritional status of the citizens will be improved.

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