

## MICROBIOLOGICAL EVALUATION OF PRECOOKED GOAT "BUCHADA"

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### ABSTRACT

The objective of the present work was to evaluate the microbiological characteristics of the precooked goat "buchada", a typical dish in North East of Brazil, composed mainly by goat viscera such as heart, lungs, liver, spleen, intestines, stomach and blood. Samples of "buchada" produced at the different areas of the State of Paraíba, Brazil, presented a high number of aerobic mesophilic bacteria, with values ranging from 5.5 to 6.9 log<sub>10</sub> CFU/g. All samples presented total coliforms, and 96.6% presented fecal coliforms, with values between 2.3 and 5.0 log<sub>10</sub> NMP/g. The occurrence of *Staphylococcus aureus* was observed in one sample only, at a proportion of 4.0 log<sub>10</sub> CFU/g. *Salmonella* was absent in all samples. Water activity was around 0.98 and pH close to neutrality except for the samples collected in Campina Grande which presented pH 5.1, significantly lower ( $p < 0.05$ ) than the other products. Results indicate inadequate hygienic-sanitary practices during slaughter and processing, requiring preventive measures to minimize contamination at the critical points of the process and to guarantee products with longer shelf life and desirable quality standards.

**Key word:** organs, viscera, hygienic-sanitary conditions, "buchada"

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### INTRODUCTION

Goat breeding has grown as profitable activity for the Brazilian economy in the last years, especially in the Northeastern region due to the adaptability of goats to the semiarid climate and to lesser nutritional requirement they present. The meat of the animals is the most valuable product but by-products increase profitability of the process.

The demand for processed viscera has increased significantly in large Brazilian urban centers (4). However, society still presents a negative perception of the edible components not belonging to carcass of small ruminants, associating them to low-quality products. According to Zapata (22) goat products do not take part of the Brazilian population food habits especially due to their low quality as result of the

large number of illegal slaughterhouses, lacking any sanitary surveillance.

The "buchada", a traditional Brazilian dish, represents an important economic alternative for utilization of edible components not belonging to carcass, which yield may exceed 20% in relation to the live weight and a budget equivalent to 50% of the total obtained with the carcass (8). Generally, the "buchada" is composed of heart, lungs, liver, spleen, intestines, stomach and blood, and these components must be rationally handled in order not to impair the consumers' health, once these components are vulnerable to microbial contamination (10).

The need to assure microbiological safety and food quality as well as longer shelf life has stimulated the performance of researches. Some microorganisms of interest in the evaluation of the precooked goatlike "buchada" are coliforms, indicative

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of fecal contamination during slaughter/processing, also indicating the possible presence of pathogen microorganisms. Santos *et al.* (18) mentioned many authors and emphasized among pathogen microorganisms the *Salmonella* spp. as the second cause for food-induced bacterial diseases in the period from 1995 to 1998 in Latin America, only behind *Staphylococcus* sp., and that from the *Salmonella* vines isolated in the state of São Paulo in the period from 1985 to 1996, 34% were originated from meat and by-products. Frazier and Westhoff (8) emphasized that spores produced by some bacteria present thermic resistance of up to 20 hours at 100°C for their complete destruction.

The determination of the microbial load of the commercialized precooked goatlike “buchada” along with the follow up of the processing stages will allow detecting the critical points of the productive process for solution in further stage, thus decreasing the incidence of deteriorating and pathogen microorganisms. These aspects would guarantee good physical-chemical and sensorial quality products with the maintenance of their original properties and the reduced risk of alimentary toxoinfections and increased shelf life as result (6).

The objective of this work was to evaluate the microbiological quality of the precooked goatlike “buchada” based on the total counting of aerobic mesophilic bacteria, total and fecal coliforms, *Staphylococcus aureus* and *Salmonella* spp. determination as well as pH and water activity values.

## MATERIALS AND METHODS

The experiment was conducted using precooked goatlike “buchada” produced in informal slaughterhouses in cities of Campina Grande, Remígio, Barra de Santa Rosa, São João do Cariri and Patos, including the Agreste, Borborema and Sertão regions in the state of Paraíba. Four sequenced collections were performed in a period of seven consecutive days and the samples were collected in the five cities previously mentioned, totaling 20 samples. At the end of this process, the microbiological analyses were conducted in the following week, procedure adapted to the other samples.

All slaughter and processing stages of the product were followed, in other words, anesthetizing, bleeding, skinning, cleanliness, thermic treatment of viscera and confection of the “buchada” without, however, interfering in the process methodology. The samples collection was performed shortly after the attainment of the final product.

For transportation, the samples were packed in transparent plastic sacks with hermetic seal previously sterilized with iodinated alcohol and registered in informative cards containing date and place of collection. The samples were transported in isothermal boxes with ice to the microbiology laboratory and frozen in freezer under average temperature of -10°C for a period not longer than seven days. The microbiological analyses were

conducted in the Food Quality Control Laboratory of the Technicians Formation Center - Paraíba Federal University.

### “Buchada” processing flowchart

The “buchada” processes, performed in the stores selected generally follow the same slaughter and production flowchart (Fig. 1).

The slaughter process was composed of anesthetizing through the traditional method of losing consciousness with the use of a wooden stick, suspension of the animal through the back paws and bleeding through jugular vein incision, where blood was collected in recipient and left until complete coagulation. In the Campina Grande slaughterhouse, the blood was not collected. The skin and the limbs extremities were manually removed with the aid of knives.

Evisceration started with white organs; stomach and intestines with the removal of the gastrointestinal content and later washing. The guts were removed with the aid of a stick

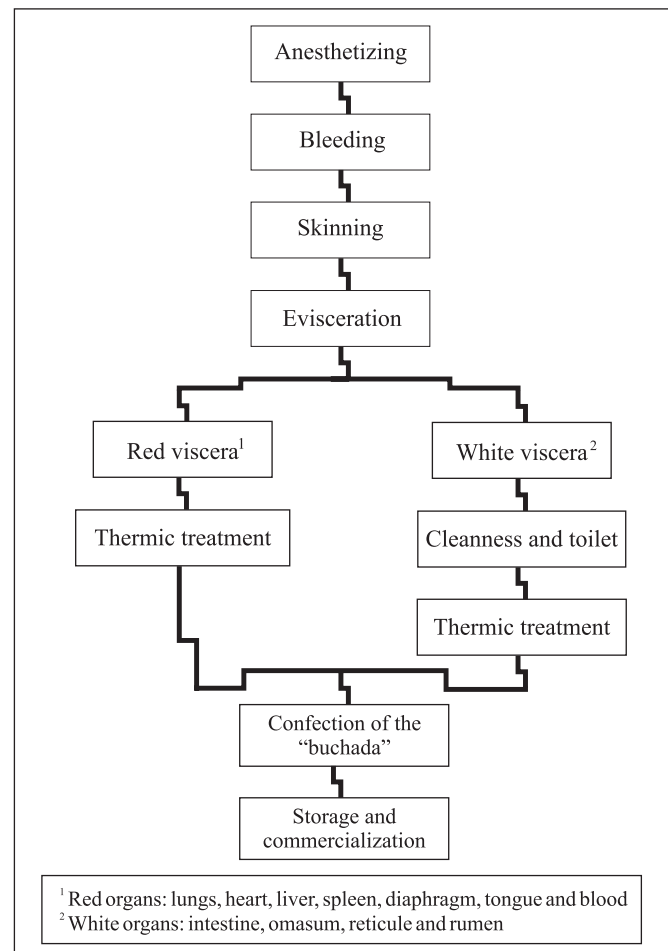


Figure 1. “Buchada” production stages flowchart.

and in the case of the reticule-rumen, the interior mucosa was removed through immersion in water at 70°C for an average period 5 minutes. When the cleanness process finished, the thermic processing was performed, except for the reticule-rumen that were cut and sewed in form of sacks or bags for further filling with minced viscera (minced).

The red viscera initially removed from head, trachea and esophagus were scalded along with the coagulated blood for a period no longer than 30 minutes under water temperature ranging from 70 to 90°C. The confection of the “buchada” consisted of cutting the red and white (minced) viscera and adding greenery and seasonings followed by the filling and closing of the “paunch”, thus obtaining the final product.

### Microbiological analyses

For the performance of the microbiological analyses, the samples were initially triturated in triturating equipment (Stomacher) for an average period of 5 minutes. Dilutions from  $10^{-1}$  to  $10^{-6}$  were performed and the inoculations were performed according to methodology proposed by Vanderzant and Splittstoesser (20) for the performance of the total counting of aerobic mesophilic bacteria, determination of the most probable number per gram of total and fecal coliforms, counting of *Staphylococcus aureus* and determination of *Salmonella* ssp.

Total counting of aerobic mesophilic bacteria - Using Plate Count Agar-PCA agar (BD), as culture medium, with inoculation by spread plate followed by incubation at 35°C during 48h. Results were expressed as CFU/g.

Total and fecal coliforms - The most probable number (MPN) of total coliforms was estimated by the 5-tube method using Lauryl Tryptose broth (Difco) incubated at  $35 \pm 0.5^\circ\text{C}$  and confirmed in brilliant Green Lactose bile broth (Difco) also at  $35 \pm 0.5^\circ\text{C}$ . The fecal coliforms counts were estimated after incubation at  $44.5 \pm 0.2^\circ\text{C}$  in EC medium (Difco).

*Staphylococcus aureus* - Samples were serially diluted in sterile 0.85% saline and aliquots of 0.1mL were surface plated on Baird Parker agar (Oxoid) and incubated at 37°C for 24 - 48h. From each plate, five grey to black colonies, with or without halos, were selected and transferred to slants of Tryptic Soy Agar and incubated overnight at 37°C.

*Salmonella* ssp. - Twenty-five g of sample were homogenized with 225 mL Lactose Broth (Difco) and incubated for 24h at 35°C. One mL of the lactose broth was also transferred to Kaufman’s Tetrionate Broth (Merck) and incubated for 24h at 35°C. Was then streaked on Bismuth Sulphite Agar (Difco), XLD Agar and Hectoen Enteric Agar plates and incubated for 24h at 35°C. When suspect *Salmonella* colonies were present, they were transferred to TSI and LIA agar (Difco) slants and incubated for 24h at 35°C.

The pH determinations were conducted according to the AOAC (1). The water activity ( $A_w$ ) was performed through direct method using hygrometer DECAGON DEVICES, label AQUA LAB, model CX2, according to manufacturer’s instructions.

### Experimental design and statistical analysis

The design used was fully random with five treatments and represented by the product acquired in each city (Campina Grande; Patos; Remígio; Barra de Santa Rosa; São João do Cariri). The four collections performed in each city were characterized as repetitions of the experiment.

The values obtained from the microbiological analyses corresponding to the counting of aerobic mesophilic bacteria, total and fecal coliforms and *Staphylococcus aureus* were transformed into base-10 logarithms for the performance of the statistical analysis. The averages were compared with the Tukey test at the significance level of 5% of probability using the PROC GML from the SAS program as software (19).

## RESULTS AND DISCUSSION

Skinning and evisceration are considered as the main critical points during slaughter as result of the high microbial load present in skin, stomach and intestines (5). An average time between bleeding and evisceration of approximately 20 minutes was observed in stores visited.

The use of wooden boards, knives, plastic recipients and the handling of the product without previous hands and tools hygienics may be considered as critical points of the process. Rezer (16) verified the presence of a large number of aerobic mesophilic bacteria in goat viscera *in natura* as result of the lack of cleanness and disinfections of surfaces and equipments and the inadequate time and temperature conditions during food processing and conservation.

The lack of adequate tools such as pinafores, caps, masks and boots were also remarkable characteristics of the stores visited. Latre *et al.* (12) performed different microbiological analyses in order to evaluate the microbial load of meats and found the highest values of microorganisms counting in the surface of equipments in the evisceration sector, ranging from 4.0 to 6.0  $\log_{10}$  CFU/g.

The processes performed at Campina Grande and Barra de Santa Rosa presented times of viscera precooking below 20 minutes with temperatures not higher than 70°C. In Patos, Remígio and São João do Cariri, a precooking time of 30 minutes was recorded at approximately 90°C. Rezer (16) reported a reduction on the microbial load of goat viscera *in natura* of the order of 80% after thermic treatment with water at 90°C without previous time control.

In cities of Campina Grande, Remígio, São João do Cariri and Patos, the washing of viscera with citric acid and/or acetic acid was performed after thermic treatment. According to Vasconcelos *et al.* (21), the washing with acetic acid at 1% was effective in the pH reduction and in the significant reduction on the microbial load of sheeplike meat *in natura* without hindering the sensorial and nutritional quality of the product. Rezer (16) assured that the reduction on pH significantly decreases the

microbial development, once the vast majority of pathogenic and deteriorating species multiply in pH values close to neutrality.

Among the edible components not belonging to carcass used in the confection of “buchadas”, it was observed that the spleen is one of the components of the product present in all stores visited, except for the product acquired in Patos. The consumption of this organ is forbidden in Brazil, according to the article 260 of the Industrial and Sanitary Surveillance Regulation of Animal Origin Products (RIISPOA) (2), although it is commonly consumed in many countries due to its expressive nutritional value and high amino acids and iron contents (14).

Except for the “buchada” produced in Barra de Santa Rosa, the other products acquired in the region visited present large amounts of intestines in their composition, what may lead to a larger microbial counting in the final product, in case the cleanness and precooking stages are not properly performed. Rezer (16) evaluated the microbial load of goat intestines *in natura* commercialized in free markets and supermarkets and verified high concentrations of total and fecal coliforms, around 6.0 log<sub>10</sub> NMP/g.

Due to the lack of microbiological standards for the precooked goatlike “buchada” in the Brazilian legislation, the general meat specifications were considered as parameter for the evaluation of the product.

It was verified that the “buchadas” analyzed, acquired in the five cities visited, presented high number of aerobic mesophilic bacteria, with values ranging from 5.5 to 6.9 log<sub>10</sub> CFU/g, indicating high contamination during the product’s slaughter and processing stages (Table 1). Fung *et al.* (9) defined the range of 5.0 to 6.0 log<sub>10</sub> CFU/g as high aerobic microorganisms contamination, considering values up to 4.0 log<sub>10</sub> CFU/g as acceptable. However, Jay (11) reported that a counting of total aerobic mesophilic bacteria between 5.0 and 7.0 log<sub>10</sub> CFU/g for raw meat are considered as normal and that for values above this range, one already observes the presence of unpleasant odors.

All samples presented total coliforms and 96.6% of them presented fecal coliforms between 2.3 and 5.0 log<sub>10</sub> NMP/g,

showing inadequate hygienic-sanitary conditions in the processing of the product (Table 1). Values above those detected in this study were found by Madruga *et al.* (13) in goat viscera *in natura*: heart, lungs, liver, stomach and intestines; with values for total and fecal coliforms ranging from 5.4 to 6.8 log<sub>10</sub> NMP/g, respectively, indicating strong contamination during slaughter and/or processing stages.

In resolution RDC n° 12 (3), there are no standards established for NMP/g of total and fecal coliforms for goatlike viscera and not specifically for “buchada” either; however, it only specifies that for poultry giblets, the maximum value allowed is of 5.0 log<sub>10</sub> NMP/g.

The occurrence of *S. aureus* was observed only in one sample from the city of Campina Grande at the proportion of 4.0 log<sub>10</sub> CFU/g. The presence of this type of microorganism is strongly related to precarious hygiene conditions. This pathogen is easily destroyed at temperatures close to 100°C, however, it produces enterotoxins that cannot be eliminated even at temperatures above 100°C (17). Values above 6.0 log<sub>10</sub> CFU/g of this microorganism in food produce sufficient amounts of enterotoxins capable to cause gastroenteritis (15).

The result of the *Salmonella* spp. evaluation was absent in 25g of product for all “buchada” samples evaluated. Madruga *et al.* (13) verified presence of *Salmonella* spp. in intestine samples, considering them inadequate to consumption.

The expressive water availability for the microbial development, verified by the high Aw values and pH close to neutrality found in “buchada” samples acquired in cities of Patos, Remígio, Barra de Santa Rosa e São João do Cariri demonstrated favorable conditions for microbial development, what characterizes the “buchada” as a product highly perishable (Table 2). Similar values were reported by Madruga *et al.* (13) for water activity and pH in goatlike viscera *in natura*.

The “buchada” acquired in Campina Grande presented low pH, unlike the other products evaluated probably as result of the production of lactic acid originated from the beginning of the microbial deterioration process, once in the methodology applied, no viscera washing with citric acid or acetic acid was performed.

**Table 1.** Microbiological evaluation (log<sub>10</sub>) of precooked goatlike “buchada” produced in the state of Paraíba.

Microbiological Parameter (log <sub>10</sub> )	City					CV <sup>1</sup> (%)
	C.Grande	Patos	Remígio	B.S. Rosa	S.J. Cariri	
aerobic mesophilic (CFU/g)	6.1	6.5	6.9	5.7	5.5	12.34
Total coliforms (NMP/g)	5.0 <sup>a</sup>	3.7 <sup>ab</sup>	3.6 <sup>ab</sup>	2.6 <sup>b</sup>	2.7 <sup>ab</sup>	29.53
Fecal coliforms (NMP/g)	5.0 <sup>a</sup>	3.7 <sup>ab</sup>	3.4 <sup>ab</sup>	2.6 <sup>b</sup>	2.3 <sup>b</sup>	28.59
<i>Staphylococcus aureus</i> (CFU/g)	4.0	Absent	Absent	Absent	Absent	-
<i>Salmonella</i> ssp	Absent	Absent	Absent	Absent	Absent	-

Averages followed by different letters in line are different from each other by the Tukey test (p<0.05); <sup>1</sup>Variation Coefficient.

**Table 2.** Water activity ( $A_w$ ) and pH of precooked goatlike “buchada” produced in the state of Paraíba.

Parameter	City					CV <sup>1</sup> (%)
	C. Grande	Patos	Remígio	B.S.Rosa	S.J.Cariri	
<b><math>A_w</math></b>	0.98	0.98	0.98	0.98	0.98	0.48
<b>pH</b>	5.1 <sup>b</sup>	6.3 <sup>a</sup>	6.5 <sup>a</sup>	6.7 <sup>a</sup>	6.5 <sup>a</sup>	7.67

Averages followed by different letters in line are different from each other by the Tukey test ( $p < 0.05$ ); <sup>1</sup>Variation Coefficient.

Pearson and Dutson (15) demonstrated that water activity values close to 0.96 are already sufficient to inhibit the growth of deteriorating bacteria; however, not sufficient to inhibit the development of deteriorating fungi and yeast, capable to multiply in  $A_w$  as low as 0.88.

### CONCLUSIONS

The “buchada” samples analyzed presented high values for aerobic mesophilic bacteria and total and fecal coliforms counting, suggesting inadequate hygienic-sanitary conditions in slaughter and processing stages, where the adoption of preventive measurements are required with the objective of minimizing contamination in critical points of the process in order to provide longer shelf-life and improved microbiological quality.

One verifies the need of a legislation with specific standards for the counting of aerobic microorganisms, total coliforms, fecal coliforms and *Staphylococcus* for the edible components not belonging to carcass and specially for the “buchada”, due to the cultural and economical role it plays, especially in the Brazilian Northeastern region.

The high  $A_w$  values and pH close to neutrality demonstrated favorable conditions for microbial development, what characterizes the “buchada” as a highly perishable product.

### RESUMO

#### Avaliação microbiológica da “buchada” caprina pré-cozida

Objetivou-se com o trabalho avaliar as características microbiológicas da “buchada” caprina pré-cozida, produto típico da culinária nordestina no Brasil, normalmente composta por vísceras, como coração, pulmões, fígado, baço, intestinos, estômago e sangue. As amostras de “buchada” produzidas em diferentes mesorregiões do estado da Paraíba apresentaram elevado número de bactérias mesófilas aeróbias, com valores variando de 5,5 a 6,9  $\log_{10}$  UFC/g. Todas as amostras apresentaram coliformes totais, das quais 96,6% continham coliformes fecais, entre 2,3 e 5,0  $\log_{10}$  NMP/g. A ocorrência de *Staphylococcus aureus* foi observada apenas em uma amostra

proveniente do município de Campina Grande, na proporção de 4,0  $\log_{10}$  UFC/g. *Salmonella* foi ausente para todas as amostras avaliadas. A atividade de água obtida foi em torno de 0,98, com valores de pH próximos da neutralidade, exceto nas amostras adquiridas em Campina Grande que apresentaram pH em torno de 5,1, diferente ( $p < 0,05$ ) dos demais produtos. Conclui-se com os resultados, condições higiênico-sanitárias inadequadas nas etapas de abate e confecção da “buchada”, fazendo-se necessário adotar medidas preventivas, com o intuito de minimizar a contaminação nos pontos críticos do processo e garantir produtos com maior tempo de vida útil e um padrão de qualidade desejável.

**Palavras-chave:** órgãos, vísceras, condições higiênico-sanitárias, “buchada”

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