

Qualidade de cortes de carne de frango comerciais “*in natura*” e temperado do sudoeste de Goiás

Quality of commercial chicken *cuts fresh* and with seasoning in the southwest of Goiás

Calidad de cortes comerciales de carne de pollo "*in natura*" y sazonados del suroeste de Goiás

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Resumo

Em decorrência da boa aceitabilidade, de ser um produto de fácil acesso e economicamente viável para o consumo, a produção da carne de frango vem aumentando muito nas últimas duas décadas. A presente pesquisa teve como objetivo avaliar a qualidade microbiológica, físico-química da carne de frango “*in natura*” e temperada comercializada na cidade de Santa Helena de Goiás. As amostras foram coletadas em quatro estabelecimentos comerciais e foram realizadas análises microbiológicas de coliformes totais, termotolerantes e de *Salmonella* spp., análises físico-químicas de pH, acidez e retenção de água. Os resultados obtidos nas análises microbiológicas para coliformes totais e termotolerantes mostraram que as amostras encontraram acima do estabelecido pela Instrução Normativa nº 62, de 18/09/2003, pelo Ministério da Agricultura, Pecuária e Abastecimento (MAPA). Para as análises de *Salmonella* spp., houve presença do micro-organismo, em três dos quatro amostras avaliadas. Os resultados evidenciaram que o pH das amostras estava na faixa de 6,17 a 6,53 condizente com valores encontrados na literatura. E houve uma pequena variação nas amostras analisadas de acidez. Somente uma amostra, dentre as quatro avaliadas, mostrou maior retenção de água. Assim, foi possível concluir que as carnes de frango “*in natura*” e temperadas analisadas, não estão em condições higiênico-sanitárias adequadas para o consumo.

Palavras-chave: deterioração; legislação; alimento seguro; fiscalização.

Abstract

Due to the good acceptability and being an easily accessible and economically product for consumption, the production of chicken meat has been increasing in the last two decades. That said, it was aimed with this research to evaluate the microbiological, physicochemical quality of fresh and seasoned chicken meat commercialized in the city of Santa Helena de Goiás. The samples were collected in four commercial establishments and then there were carried out microbiological analyzes for total, thermotolerant coliforms and *Salmonella* spp, physical and chemical analyzes for pH, acidity and water retention. The results obtained in the microbiological analyzes for total and thermotolerant coliforms showed that the samples were above the limits established by Normative Instruction No. 62, of 09/18/2003, by the Brazilian Ministry of Agriculture, Livestock and Supply. For *Salmonella* spp. evaluation the microorganism was present in 25g in three from the four samples evaluated. The pH of the samples ranged from 6.17 to 6.53, consistent with values found in the literature. A there was a small variation in the analyzed samples acidity. Only one sample, among the four evaluated

showed higher water retention. Thus, it was possible to conclude that the fresh and seasoned chicken cuts analyzed were not in hygienic-sanitary conditions suitable for consumption.

Keywords: deterioration, legislation, food safety, inspection.

Resumen

Debido a la buena aceptabilidad de ser un producto de fácil acceso y económicamente viable para el consumo, la producción de carne de pollo ha aumentado mucho en las últimas dos décadas. La presente investigación tuvo como objetivo evaluar la calidad microbiológica, físico-química de la carne pollo *fresco* y sazonado comercializado en la ciudad de Santa Helena de Goiás. Se recolectaron muestras en cuatro establecimientos comerciales y análisis microbiológicos de coliformes totales, termotolerantes y de *Salmonella* spp., análisis físico-químicos de pH, acidez y retención de agua. Los resultados obtenidos en los análisis microbiológicos para coliformes totales y termotolerantes mostraron que las muestras encontradas por encima de lo establecido por la Instrucción Normativa n° 62, del 18/09/2003, por el Ministerio de Agricultura, Ganadería y Abastecimiento (MAPA). En el análisis de *Salmonella* spp., hubo presencia del microorganismo en tres de las cuatro muestras. Los resultados mostraron que el pH de las muestras estaba en el rango de 6.17 a 6.53 consistente con los valores encontrados en la literatura, y hubo una pequeña variación en las muestras analizadas de acidez. Solo una muestra, entre las cuatro evaluadas, mostró una mayor retención de agua, por lo que fue posible concluir que las carnes de pollo "*frescas*" y sazonadas analizadas no se encuentran en condiciones higiénico-sanitarias adecuadas para el consumo.

Palabras clave: deterioro; legislación; alimentos seguros; inspección.

1. Introduction

The Brazilian chicken production chain is one of the most important in the world. The supply of Brazilian chicken besides accompanying the growth of domestic and foreign demand, due to increased competitiveness and productivity, also accompanied the increase in the level of urbanization and income of the population, diversification of diets and changes in dietary habits. Brazil is the third largest producer of chicken meat in the world, producing a total of 12.6 million tons of chicken in 2014, behind the US with a production of 17.2 million tons and China with a production of 13 million tons. Since 2010, the country has been the world leader in the export of chicken meat, according to the Brazilian Association of Animal Protein (Abpa, 2015).

Researches indicate that the preference of Brazilian consumers for poultry meat is about 75% when compared to beef or pork (Garcia et al., 2017; Mendes et al., 2016). The growth in the production and consumption of poultry meat is accompanied by a greater diversification of products, more elaboration of convenience items, practicality and added value. This is due to the changing habits of the population, since the practicality, convenience, nutritional quality and more affordable prices are basic conditions for the food business (Olivo, 2006).

According to the Brazilian Association of Collective Meals Companies (Aberc, 2000), microbiological and physicochemical analyzes should be performed to evaluate the quality of the production process and food quality, assessing the degree of contamination by deteriorating microorganisms, in addition to guiding monitoring and indicating corrective measures at critical control points.

Chicken meat kept at refrigeration temperature has a short shelf life from three to ten days, depending on the production and conservation strategies practiced by the industry. However, this product undergoes alterations in its sensorial, nutritional and microbiological characteristics if this period is abusive or if it is not obeyed to the technical requirements appropriate to the cooling process (Venturini et al, 2007).

Therefore, the objective with this study was to evaluate the indicators and quality by means of microbiological and physicochemical analyzes of fresh and seasoned chicken cuts from four commercial stores in the city of Santa Helena de Goiás, two butcher shops and two supermarkets.

2. Material and Methods

In the present study, the quantitative method was used to evaluate the data. This method generates sets or masses of data that can be analyzed using mathematical techniques such as percentages, statistics and probabilities, numerical methods, analytical methods and generation of equations and / or mathematical formulas applicable to any process. (Pereira et al., 2018).

2.1 Materials

It was purchased 250 grams of chicken with and without seasoning in two butcher shops and two supermarkets in the city of Santa Helena de Goiás, Goiás (GO) without any type of identification and validity period, totaling eight samples, which is offered for sale in portions. These products are usually obtained directly from the slaughterhouse and distributed

to the butcher shops, markets and supermarkets of the city and some towns in the region. The samples were transported in thermal boxes containing ice to the Food Microbiology Laboratory of the Goiano Institute of Education - Rio Verde Campus. Then, a 25g sample was aseptically separated from each batch for microbiological analyzes, 10g for pH and acidity analyzes and 5g for water retention. Analyzes of pH, total titratable acidity and water retention capacity were performed in triplicate.

2.2 Microbiological analyses methods

The determination of Total and Thermotolerant Coliforms and *Salmonella* spp were performed according to Normative Instruction No. 62 of August 26, 2003, of the Ministry of Agriculture, Livestock and Supply (Mapa, 2003). The results were compared to the standards determined by Resolution RDC No. 12 of January 2, 2001 (Brasil, 2001).

2.3 Physical and chemical analysis

The pH was determined directly by benchtop pH meter and titratable total acidity by titration of sodium hydroxide solution according to the official methods (Ial, 2008). Titratable total acidity was expressed as a percentage of lactic acid. The water retention capacity (WRC) was determined according to the methodology of (Osório et al., 1998) adapted. Samples weighing 0.5g were compressed by a bottle of water weighing 2.25 kg for 5 minutes, after that the samples were weighed in analytical balance. The WRC was calculated according to Equation 1.

$$\%LE = \frac{(FW - IW) \times 100}{IW} \quad (1)$$

Where LE = Loss of Exudate; FW = Final weight; IW = Inicial weight. The amount of water retained was obtained, the final result being expressed as a percentage of retained water in relation to the initial weight of the sample.

2.5 Staticial evaluation

The experiment was conducted in a completely randomized design (CRD), in factorial scheme 4 (4 places = 2 butchers and 2 markets) × 2 (2 types of products = with and without condiments). The results were evaluated through analysis of variance and Tukey test with 95% confidence degree.

3. Results and Discussions

The practice of seasoning raw meat can mask changes in the aroma and texture of the meat, facilitating the marketing of products that are not always in proper conditions for consumption. Many microorganisms can cause foodborne infections, but Brazilian legislation only highlights thermotolerant coliforms as a control parameter (Brasil, 2001).

The results obtained from the analysis of total and thermotolerant coliforms are described in Table 1. The samples of chicken meat from site 3, presented contamination by thermotolerant microorganisms, varying from <3,0 to > 1100 MPN / g and legislation establishes the maximum of MPN 10⁴ / g, consequently the chicken meat purchased in this place was considered in unsatisfactory conditions for consumption.

Table1. MPN microbiological analyses for total, thermotolerant coliforms and *Salmonella* spp. analyses in fresh and seasoned chicken cuts sold in butcheries and supermarkets in the city of Santa Helena de Goiás.

Market	Total Coliforms (MPN/g)		Thermotolerant Coliforms (MPN/g)	
	Fresh	Seasoned	Fresh	Seasoned
1	> 1100	> 1100	< 3,0	< 3,0
2	210	> 1100	< 3,0	< 3,0
3	> 1100	> 1100	> 1100	> 1100
4	> 1100	> 1100	< 3,0	< 3,0

The detection of a high number of bacteria in the group of thermotolerant coliforms in foods is interpreted as indicative of the presence of intestinal pathogenic microorganisms coming from the manipulators. This can happen by cross-contamination, when the bleeding knife that is being used was not sterilized before each slaughter. Other sources of cross-contamination are related to the gastrointestinal tract that has a large and varied microbial flora and, if punctured, can contaminate the entire carcass; the hands of the manipulators, which are one of the most important sources of cross-contamination, meat-storage containers that are not sterilized carry contaminating microorganisms; and the handling and storage environment that may allow contamination by air or on the support benches (Carvalho et al., 2005; Jay, 2005).

Regarding to the microbiological analysis, the cuts of meat chicken presented contamination by microorganisms, even in the presence of the seasoning. According to (Pinto et al., 2002), the addition of salt and condiments is one of the oldest mechanisms of food preservation, the presence of coliform microorganisms, such as *E. coli*, is an indicator of poor sanitation in food handling and contamination index they can be resistant to mild concentrations of salt (up to 5%) in foods.

The values found for Total Coliforms are described in Tab. 1, and were considered unsatisfactory for all samples, based on standards determined by RDC Resolution No. 12 of January 2, 2001 (Brasil, 2001). Although the current legislation does not establish microbiological parameters for total coliforms, these analysis were performed to know the microbial load and thus to evaluate the hygienic-sanitary conditions of the chicken cuts, since these parameters reflect in the care with which the manipulators handle the food, raw material quality and environmental hygiene.

For the reduction of these values present in the analysis of coliforms it is necessary to invest in constant training for professionals involved directly in the manipulation in establishments where food handling occurs, it is mandatory to have the GMP (Good Manufacturing Practices) manual, in addition to one responsible for such as food contaminants, foodborne diseases, hygienic food handling, and good practices to ensure that the product has guaranteed quality for consumption (Brasil, 2004).

Salmonella spp.

Salmonella spp. represents the most important microorganism involved in chicken-based food contamination (Ruckert et al., 2006). It is showed in Table 2 the results for *Salmonella* spp analysis in chickens cuts from the evaluated collection sites. After all, it was possible to observe that only market 1 did not present the presence of a pathogenic microorganism. The meats of seasoned and fresh chicken had the same result, concluding that the seasoning in this study did not inhibit the presence of microorganisms. It was reported by (Rodrigues, 2005), that the resistance of *Salmonella* spp to salt tolerance, acid resistance and thermoresistance are interdependent. Certain processes such as brine (9.0% salt) and smoking have a limited effect on salmonella survival.

Table 2. *Salmonella* spp. analyses in fresh and seasoned chicken cuts sold in butchereries and supermarkets in the city of Santa Helena de Goiás.

***Salmonella* spp.**

Market	Fresh	Seasoned
1	Ausência	Ausência
2	Presença	Presença
3	Presença	Presença
4	Presença	Presença

Carriage of poultry is a major source of contamination, usually confined and packaged in boxes over long distances under inadequate sanitary conditions, which can increase the risk of contracting salmonella cross infections. Other factors such as the slaughtering and processing of carcasses also contribute to the dissemination and multiplication of salmonella that can occur through scalding water, the plucking process, cross contamination of equipment and utensils, improper handling during cutting, evisceration and packaging that is normally carried out at room temperature until it is commercialized (Tirolli and Costa, 2006).

Both final pH values and fall velocity values affect color characteristics, juiciness, taste, water retention capacity and meat storage capacity (Cezar and Sousa, 2007). Tab. 3 presents the values of Water Retention Capacity (CRA), pH and total titratable acidity of the chicken meat samples studied. The pH values of this study ranged from 6.17 to 6.53. The addition of seasoning in chicken meat altered the pH values of market 2 (decreasing from 6.53 to 6.27) and 4 (increasing from 6.17 to 6.50).

Table 3. WRC (Water Retention Capacity), pH and Acidity values of fresh and seasoned chicken cuts sold in butchereries and supermarkets in the city of Santa Helena de Goiás.

Market	WRC		pH		Acidity	
	Fresh	Seasoned	Fresh	Seasoned	Fresh	Seasoned
1	42,85 ^{aA}	24,08 ^{abB}	6,30 ^{abA}	6,30 ^{aA}	3,14 ^{abA}	2,00 ^{aB}
2	19,09 ^{bA}	18,84 ^{bA}	6,53 ^{aA}	6,27 ^{aB}	1,96 ^{Ac}	1,72 ^{aA}
3	27,40 ^{bA}	23,00 ^{abA}	6,17 ^{bA}	6,17 ^{aA}	3,39 ^a	2,75 ^{aB}
4	26,50 ^{bB}	36,18 ^{aA}	6,17 ^{bB}	6,50 ^{aA}	2,34 ^{bcA}	1,85 ^{aB}

Averages followed by lower case letters in the lines differ at the 5% probability level. Averages followed by uppercase letters in the columns differ at the 5% probability level.

Chicken meat is very susceptible to deterioration due to its high nutrient content, high water activity and pH close to neutrality (pH = 7.2), which are factors favorable to the

development of microorganisms originated from the poultry itself or from external sources, for these reasons the meat must be kept under refrigeration or freezing (Silva et al., 2002).

Therefore, in the present study it was possible to observe that microbiological quality is related to the pH values and several factors as the temperature control influences the bacterial propagation in the chicken meat. According to (Lima, 2005; Góez et al., 2004), the lack of temperature control in perishable food preservation not only causes significant economic and nutritional loss, but also compromises health security and alters sensory characteristics of food.

According to (Jay, 2005), most microorganisms grow better with pH values around 7.0 (6.6-7.5), although some grow at pH below 4.0. Bacteria tend to be more demanding in terms of pH than molds and yeasts and among these, pathogenic bacteria is even more demanding.

The initial pH value in the chick muscle after slaughter is approximately 7.0 in a condition considered normal. With rigor mortis the pH drops to approximately 5.8 (Shimokomaki et al., 2006). The pH drop in the meat occurs due to the biochemical process under the action of several enzymes. The glycogen content present in the muscle at the time of slaughter is the main component for postmortem glycolysis, which is performed by the anaerobic metabolic pathway accumulating lactic acid and resulting in a decline in muscle pH (Shimokomi et al., 2006). This reduction of pH is necessary for the maturation of the meat in the process of conversion of muscle into meat (Brossi et al., 2009).

The values obtained for acidity in fresh chicken meat varied (1.96 to 3.39) and had differences from one place to another (site 2 almost twice less than site 3). Regarding the addition of seasoning in the meat, all the samples had lower acid contents than the fresh samples, and significant differences occurred in the samples obtained from sites 1, 3 and 4. The results of acidity can be justified by the storage conditions (time and temperature the meat was submitted), which vary from one place to another, influencing the chemical changes and the quality of the meat, the types of condiments used for the seasoning of the meats, among others.

The fresh meat samples from site 1 showed differences compared to the samples from the other sites studied, which may have been influenced by factors such as age, type of muscle and pre-slaughter factors. The great loss of water is not desirable to the consumer or to the traders, because it causes losses by leaching of vitamins, soluble proteins and the sensorial characteristics of the meat, such as succulence, coloring, softness and texture, which interferes with the quality of the product and, consequently, its sensory acceptability in consumption.

With relation to CRA analyzed in the temperate of the chicken meat, it was possible to observe that the seasoning influenced the samples of sites 1 and 4, which can be justified by the amount of ingredients added that is characteristic of each sale point. The pH of the chicken meat above 6.2 indicates high water retention and consequently a short shelf life (Venturini et al., 2007). Given these points, it was possible to observe that the pH values of the chicken meats obtained from sites 1 and 4 (> 6.2), explained a higher water retention. The pH change above the normal range indicates that the food is undergoing decomposition through the action of microorganisms, rendering it unfit for consumption and influencing the tenderness, taste and other sensorial aspects of the meat (Furtado et al. al., 2015).

4. Final considerations

Altogether, it can be concluded that the chicken meats analyzed are not in adequate conditions for consumption. The results obtained for *Salmonella* spp. analyzes total Coliform and thermotolerant Coliform were not within the permitted standards established by the current legislations. Thus, the samples could be able to lead to outbreaks and alimentary poisoning.

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