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Normative ruling 32/2010 of the Ministry of Agricultural, Livestock and Food Supply – Mapa: Ratio moisture/protein contents in poultry cuts

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ABSTRACT. The Self-Program and the Program for Prevention and Control of Water Addition Products - PPCAAP aims to assess the moisture content in poultry cuts. This work aims to study the text of the law and the interpretation of data and the results obtained. It was observed that in breast samples without bones and skin results were satisfactory and remain within the limits established by legislation, while in breast samples with bone and skin, although the results obtained are within the interval limits of confidence this sample, the values obtained for moisture obey a normal curve, while the values obtained for proteins since they do not, a fact that may be associated with the grinding of the meat with bones at the time of analysis, raising levels protein in the samples. It follows that it is necessary to revise Instruction 32/2010 for a description of the methodology for quantification of proteins and humidity more specifically as regards the type of material used and detailed manner how the sample is processed for later analysis

Keywords: poultry meat legislation, poultry breast, water absorption, frauds.

Instrução Normativa 32/2010 do Ministério da Agricultura, Pecuária e Abastecimento - Mapa: Relação umidade/proteína em cortes de aves

RESUMO. O Programa de Autocontrole e o Programa de Prevenção e Controle da Adição de Água aos Produtos - PPCAAP tem por objetivo avaliar o teor de umidade em cortes de frango. Este trabalho objetiva estudar o texto da legislação, bem como a interpretação dos dados e dos resultados obtidos. Foi possível observar que nas amostras de peito sem ossos e sem pele os resultados foram satisfatórios e permanecem dentro dos limites estabelecidos pela legislação, enquanto nas amostras de peito com osso e pele, embora os resultados obtidos encontram-se dentro dos limites de intervalo de confiança desta amostragem, os valores obtidos para umidade obedecem a uma curva normal, enquanto os valores obtidos para proteínas já não o fazem, fato este que pode estar relacionado com a moagem dos ossos juntamente com a carne no momento da análise, elevando os teores de proteína nas amostras. Conclui-se que se faz necessária uma revisão da Instrução Normativa 32/2010 para melhor descrição da metodologia para quantificação de proteínas e umidade mais especificamente no que diz respeito ao tipo de material utilizado e a forma detalhada de como a amostra deverá ser processada para posterior análise.

Palavras-chave: legislação para carne de aves, peito de frangos, absorção de água, fraudes.

Introduction

Brazilian legislation is severe about the levels of water absorbed during the cooling process applied to poultry carcasses. With the purpose of inhibiting the practice of fraud and deviations of any nature, the *Ministério da Agricultura, Pecuária e Abastecimento* (Mapa), through the Department of Animal Product Inspection (Dipoa) proposed the Program for Prevention and Control of Water Addition to Products – PPCAAP, through the implementation of Self-Control Programs. This Program created the new specific legislation to evaluate the moisture content in poultry cuts, as the previous legislation was limited to the Dripping Test to control the carcasses. Considering that the parameters used to control water absorption in poultry cuts is performed by the analysis of moisture, protein and the moisture/protein relationship, and that such parameters may vary depending on the pH of the carcass, lineage and weight of the birds, this can directly influence results.

The excessive loss of water by poultry carcasses is the object of continuous and long-lasting controversies between farmers, consumers and the authorities in charge of control (Postolski & Gruda, 1986). The controversy is frequent in the carcass

commercialization process, with values above the norm, even when the water absorption process occurred within the legal levels (Sams, 2001). The excess water is not necessarily the result of fraudulent injection, but the consequence of an inadequate adjustment of variables that influence the process, the storage temperature variations, that may lead to the formation of irregular ice crystals, damaging the fibers and other meat structures, allowing the moisture to migrate at defrosting, or at the stress caused by improper handling.

The Brazilian legislation regulating the procedures for poultry slaughter is described at Ordinance No. 210 of 10/11/1998 (Brasil, 1998) and, although some of the procedures have already been outdated due to the constant changes in the process, this is the law that determines and serves as reference for the indexes of water absorption during the pre-cooling process, among other data.

At the poultry's industrialization process, particularly at the pre-freezing period, the product must be submitted to pre-cooling stages called 'pre-chiller' and 'chiller' stages, in which the product is immersed in cold water. At this moment, the muscle tissue incorporates an amount of water that should exit the poultry before freezing, otherwise the water incorporated will freeze together with the product, causing an excess weight that could lead to fraud suspicions and harm the consumer economically (Kato et al., 2013). According to Ordinance No. 210/98 (Brasil, 1998), regardless of the type of product produced (cuts or whole), the index of water absorption shall be the same, and in other words, the carcass cannot absorb more than 8% of water.

Considering that in the year 2010, the Ministry of Agriculture fined innumerous companies involved in fraud for water excess in their products, a specific program to control economic frauds, called PPCAAP- Program for Prevention and Control of the Water Addition to Products was created through Ordinance (*Ofício Circular*) no. 010/2005, replacing Ordinance no. 009/2004. From then on, companies were legally responsible for controlling the whole process, which caused a significant decrease in the number of companies involved in this type of fraud.

Still in that same year, with the same purpose of controlling the levels of water absorption in poultry cuts, the Secretary of Agricultural Defense of the Ministry of Agriculture published a review of Ordinance no. 010/2005, through the Ordinance no. 38/2010, in order to reformulate the methodology used to analyze the loss of water at defrosting. The technique involves an analysis to measure the proportion of moisture/meat protein, instead of using the dripping test. The poultry breast ('pectoralis major') was the first part to adapt to the new methodology. From December of 2010, this methodology became official also for the drumstick, thigh and whole leg of the poultry. Whole carcasses continue to be evaluated with the dripping test, also known as drip test (Freitas, Ribeiro, Kato, Shimokomaki, & Pedrão, 2014).

Certain slaughter companies in Brazil were fined for exceeding the limits of water absorption in poultry cuts, which was assessed through the analysis of the relationship between moisture and protein. This situation created considerable dissatisfaction of these companies, which led them to appeal the decision at Mapa, questioning the method of analysis used, as there are controversies about the methodology that could lead to incorrect interpretations of fraud, damaging the reputation of these companies and the consumer's trust in the product (*União Brasileira de Avicultura* [Ubabef], 2013).

Based on the need to provide an effective answer to the public in regards to the continuous disrespect for its interests, the Dipoa determines the immediate application of the Complementary Program to Prevent Fraud in Poultry Meat, with the purpose of definitively restraining this practice. Penalties to the companies fined can go from suspension of productive processes to the cancelation of the label registration. In case of relapse, the accused company may have its permit cancelled with the Dipoa (Brasil, 2010).

In 2012, the media released that two companies presented water quantities above the legal limit in poultry, in other words, they had quantities above 6%. The results obtained in the tests for marks X and Y were 7.6 and 20.6%, respectively. However, between 2006 and 2008, 76 companies were fined and 180 inspections with concluded administrative processes. Within that period, the state of Paraná had 43 concluded administrative processes, falling behind only to the state of São Paulo, with 67 fines (Freitas et al., 2014).

The methodology used to evaluate the total content of water in chilled and frozen poultry cuts, with or without skin or bones, is performed in compliance with the method used to determine moisture and the method used to determine the total content of Nitrogen, mentioned in the Normative Ruling 08 of 03/11/2009/Mapa (Brasil, 2009). In order to perform the analysis, the procedures that precede the grounding of the sample

were not mentioned, as for example, if the skin or bones are grinded together, or what is the best way to get a homogeneous sampling. Therefore, the purpose of this work was to analyze the Normative Ruling No. 32/2010 - Mapa for poultry cuts in relationship to its applicability in the laboratory through the method for determining the parameter for the evaluation of the total content of water in poultry cuts, and the determination of the relationship Moisture and Protein.

Material and method

Sample collection

Forty samples of boneless and skinless poultry breast and 40 samples with bone and skin, were collected at a poultry slaughterhouse located in the city of north of Paraná State, in random hours and days. After the slaughter process, the samples were packed in Ziploc® plastic packages, individually identified with labels, transported in coolers and forwarded to the UTFPR's laboratories at the Londrina Campus until the time of analysis.

Determination of the water concentration present in poultry cuts

The technique used to determine the water content present in poultry cuts was performed in accordance with the Normative Instruction no. 08 of 03/11/2009 – Mapa (Brasil, 2009), with writing described through Normative Ruling no. 25 of 07/18/2013 – Mapa (Brasil, 2013). It is grounded in the determination of the water and protein contents, and the relationship between water and protein, of fresh poultry cuts (poultry, hen, duck and cockerel), chilled or frozen, with or without skin and bones, according to the method for the determination of moisture and the method for the determination of total nitrogen, both in compliance with the Association of Official Analytical Chemists (AOAC, 1995).

Determination of the moisture/protein relationship

The current legislation was especially applied (Brasil, 2010) for this methodology. The law establishes the upper limits of tolerance allowed by Ordinance 210/98 (Brasil, 1998) for absorption and loss of water (dripping test) at poultry carcasses, which is 8 and 6%, respectively. Normative Ruling no. 32, of December 3, 2010, published at the Union Official Gazette (DOU), established the parameters for the evaluation of the total content of moisture present in chilled and frozen poultry cuts, as shown in Table 1 (Brasil, 2010).

Table 1. Parameters for the evaluation of the total content of moisture and protein present in poultry cuts, established by Normative Ruling No. 32/2010 (Brasil, 2010).

Part	Moisture (%)	Protein (%)	Moisture/Protein
Breast and Half-Breast	67.16 to 75.40	17.81 to 22.05	3.28 to 3.92
Skinless breast	73.36 to 75.84	21.05 to 24.37	3.03 to 3.55

Source: Brasil (2010).

Statistical analysis

The data analysis complied with the following criteria: Initially, the goal was to verify the homogeneity of the poultry breasts collected through random sampling at the frigorific selected for the experiment (Solanar & Salafranca, 1998). This was done through the application of a statistical control on the breasts with the purpose of verifying the occurrence of discrepant data that could affect the analysis result. At a second stage, the homogeneity statistical tests of Shapiro-Wilk were applied to verify if the data showed a relatively normal distribution, which was confirmed. Based on these premises, a descriptive statistic was developed to provide the central measures, such as median and average, standard deviation and standard error. These measures allowed the establishment of confidence intervals for each modality of moisture and protein of poultry breasts with bones and skin and skinless poultry breasts. After the confidence intervals are established, it was possible to determine the relationship between moisture and protein to compare with Normative Instruction No. 32 of December 3, 2010 (Brasil, 2010).

Results and discussion

Even when classical and applicable techniques are used, the data collected in the lab may have no quality due to the lack of homogeneity in the analysis or, still, in the sampling, resulting in high values for standard deviation, variance and errors that may harm the credibility of results. Therefore, the first step was to perform the statistical analysis of the quality control to determine moisture and protein contents, as shown in Figures 1, 2, 3 and 4. It is possible to note that the data followed the quality criteria in regards to its distribution, as the data obtained are within the lower and upper control limits, guaranteeing the absence of discrepant data that may jeopardize the quality of the experiment.

According to Normative Instruction No. 32/2010 – Mapa, the samples 'skinless breast meat' must show a level of moisture between 73.36 and 75.84 g 100 g^{-1}, and a protein index between 21.05 and 24.37 g 100 g^{-1}, resulting in ratios 3.03 and 3.55, respectively, as shown in Table 1. However, when

analyzing the established values, the resulting relationship is lower limit of 73.36/ 21.05 = 3.48 and upper limit of 75.84/ 24.37 = 3.11.

Still in accordance with this Normative, the values must be absolute, without any possibility of standard deviation or any type of error associated with the results. Consequently, the question raised by this interpretation is that there is the value determined by the text of the Normative, explicating the M/P ratio between 3.28 and 3.92, but when calculating the values obtained in the table, the result is 3.77 to 3.11. Considering

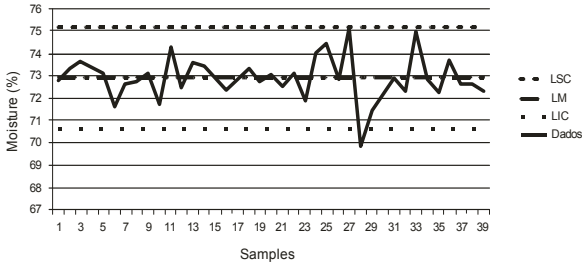

Figure 1. Data for the determination of moisture content in skinless and boneless poultry breast to determine the statistical quality standards of the sample. (Lm = medial limit; LIC = lower limit of control; LSC = upper limit of control).

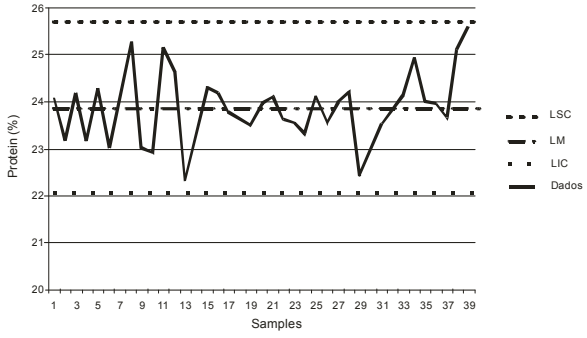

Figure 2. Data for the determination of protein content in skinless and boneless poultry breast to determine the statistical quality standards of the sample. (Lm = medial limit; LIC = lower limit of control; LSC = upper limit of control).

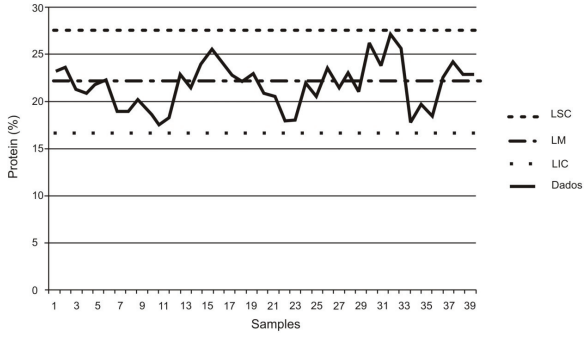

Figure 3. Data for the determination of protein content in poultry breast with bones and skin to determine the statistical quality standards of the sample. (Lm = medial limit; LIC = lower limit of control; LSC = upper limit of control).

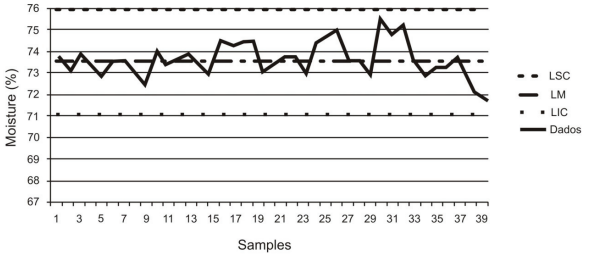

Figure 4. Data for the determination of moisture content in poultry breast with bones and skin to determine the statistical quality standards of the sample. (Lm = medial limit; LIC = lower limit of control; LSC = upper limit of control).

Table 1 shows the maximum and minimum values for both moisture and proteins, with moisture values within the amounts allowed by IN32/2010. However, this is not the case for protein values, with a limit between 21.05 and 24.37. Samples of the boneless and skinless poultry breast were analyzed, as well as poultry breast samples with bones and skin (Table 2). The samples of breast with skin and bones, in other words, the whole breast, were grinded while still frozen, as the presence of skin complicates the grind. Analysis among frozen samples, when submitted to defrosting, may interfere in the determination of moisture, because the exudate is lost in this process. The results presented here for proteins are above the maximum value in 1.59 g 100 g^{-1}. The amount obtained must be weighted, as it affects the product's suitability. On the other hand, when observing the values obtained at the statistic described, we have a median very close to the arithmetic mean, indicating once more that the data is reliable. The same experiment should be performed with a larger sampling, with the purpose of expand the sampling N, to verify the reproducibility of the result presented here.

Table 3, while working with confidence intervals obtained in the experiment, it is possible to get tabulated values for the limits permitted by law.

According to Normative Ruling No. 32/2010 – Mapa, the samples 'skinless poultry breast meat' shall present moisture between 67.16 and 75.40 g 100 g^{-1}, and proteins between 17.81 and 22.05 g 100 g^{-1}, resulting in a relation between 3.28 and 3.92, respectively. However, when analyzing the values previously established, the relation is the following: lower limit 67.16/ 17.81 = 3.77 and upper limit 75.40/ 22.05 = 3.42.

Table 3 indicates the values based on confidence intervals to allow the interpretation of part of the IN32/2010, where it is believed that the Moisture/Protein relationships are based on the means of these intervals. The calculation of these

means for the data presented by IN32/2010 could create conflict among researchers of statistics because, as previously stated, the values of its direct relations cannot be obtained through simple calculations between the M/P values indicated.

Table 2. Data obtained for the descriptive analysis for moisture and proteins of skinless and boneless poultry breast and poultry breast with bones and skin.

	Skinless and Boneless Breast		Whole Breast	
Descriptive Statistics	Moisture	Protein	Moisture	Protein
Minimum	69.84	22.3	71.28	17.83
Maximum	75.11	25.96	76.66	27.29
Total Range	5.2692	3.66	5.38	9.46
Median	72.83	23.97	73.41	21.95
Arithmetic Mean	72.89	23.87	73.42	22.03
Variance	0.8957	0.562	1.0353	5.0655
Standard Deviation	0.9464	0.7497	1.0175	2.2507
Standard Error	0.1478	0.1171	0.1199	0.3249
Variance Coefficient	1.30%	3.14%	1.39%	10.21%

Table 3. Results obtained from the calculations based on confidence intervals of the samples, based on the data obtained in IN32/2010 for boneless and skinless poultry breast meat.

	Minimum	Maximum
Confidence Interval for proteins	23.75	23.98
Confidence Interval for moisture	71.94	73.85
M/P Relation obtained	3.03	3.08
M/P Relation tabulated in the IN32/2010	3.03	3.55
M/P Relation calculated based on IN32/2010	3.48	3.11

Nevertheless, the question about this interpretation is that the values obtained in the table are 3.77 to 3.42, but the value defined by the text described at the Ruling for the M/P Relation is 3.28 to 3.92. Based on Table 4, if we work with confidence intervals obtained in the experiment, the results are close to the values tabulated for the limits allowed by legislation.

Table 4. Results obtained from the calculations based on confidence intervals of the samples, based on the data obtained in IN32/2010 for poultry breast with bones and skin (whole breast).

	Minimum	Maximum
Confidence Interval for proteins	21.70	22.36
Confidence Interval for moisture	71.00	75.85
M/P Relation obtained	3.27	3.39
M/P Relation tabulated	3.28	3.92
M/P Relation calculated based on IN32/2010	3.77	3.42

According to the Food Compositions Table, published by *Universidade Estadual de Campinas* (2011), for consumable cuts the values are skinless and raw poultry breast 74.8 and 21.5%, for poultry breast with and without skin, 71.9 and 20.8% for moisture and proteins, respectively. Galarz, Fonseca, and Prentice-Hernandez (2010), found moisture values for poultry breast that varied between 74.53 and 75.24%, while for proteins, the values were 22.53 to 22.97%. Based on the data presented by Sogunle et al. (2013), for samples of poultry breast of different lineages, the values were 20.13 to 21.71% and 69.94 to 70.89% for moisture and proteins, respectively. Moreno et al. (2000) obtained the values of 19.7% for proteins and 74.90% for moisture in poultry breast. It is worth mentioning that the routine analysis was exclusively performed just with the meat, with no grinding of bones and skin.

Although the samples complied with satisfactory sampling standards, the values obtained for moisture follow a normal curve, while the values obtained for proteins do not. Besides this important fact, a relevant finding is that the maximum value obtained for proteins in the arithmetic mean is 27.29 g 100 g^{-1}, considerably higher than the amount allowed by legislation. However, it is located within the confidence interval limits of this sample. Considering that this is a sample where the whole breast was grinded (skin and bones), it can be hypothesized that samples analyzed with bones and skin tend to indicate a higher protein value because of the composition of the tissues themselves, besides the possibility of errors in the samples' homogenization process.

Conclusion

It is possible to conclude that a better description of the methodology used for the quantification of proteins and moisture is necessary at Normative Ruling No. 32/2010. More precisely, a more detailed description of how the sample shall be processed for further analysis, as well as a deeper analysis of the protein values of samples of poultry breasts which contain only meat and whole poultry breasts, the values obtained for moisture and proteins, as well as identify if their relations are not fully located within the standards determined by the current legislation. Consequently, systematic studies are needed to solve the uncertainty that may be routinely generated during the analysis indicated by IN 32/2010.

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