

ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF
POULTRY SCIENCE

ANSI*net*

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Evaluation of Drip Test Sampling Plan in Carcasses of Frozen Broilers

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Abstract: Current assay evaluated the efficacy of the Drip Test Sampling Plan according to Brazilian legislation. The experiment was carried out in a poultry slaughterhouse under the official state supervision office, located in Recôncavo da Bahia, Brazil, between September 2011 and February 2012. Sample was prepared and its batch number was identified by the number of the truck to be unloaded on that day. One hundred and five samples were collected, with 10 chickens in each batch, for Internal Control Method. On the day after freezing, the Drip Test was conducted in 90 batches with 12 chickens each, totalizing 1.080 frozen chickens, according to the batch that had been analyzed the day before. Variables that involved the process were controlled by the industry's quality sector. The Drip Test was carried out according to the official methodology laid down by 210/1998 Ordinance of the Ministry of Agriculture, Livestock and Food Supply and compared to double the sampling plan. Results showed that the sample standard with an average of 6 carcasses was efficient when compared to the 12-carcass average.

Key words: Chicken carcass, water absorption, drip test

INTRODUCTION

During the last two decades broiler production has developed significantly and with great success in Brazil. Poultry culture has turned out to be a highly profitable investment in the wake of the country's high potential in meat production (Sousa and Osaki, 2005) and competitiveness on the international market (Sousa and Osaki, 2005; Bueno *et al.*, 2007).

The insertion of the Brazilian broiler industry on the international market occurred in 1998 when great enterprises and several agricultural cooperatives started to invest in the poultry sector and generated a surplus production over internal consumption, with price stability (Pessoa *et al.*, 2010). As from 2000, the Brazilian production of broilers grew to high proportions and by 2004 Brazil became a leader in poultry meat world exports (Carvalho *et al.*, 2008).

Ranking third on the world scenario in the production of broiler meat and going on to second place in 2012 (Ubabef, 2012), Brazil became the main supplier worldwide, with exports to several countries, especially to the Middle East (Pessoa *et al.*, 2010). Record statistics are evident for the sector, with a production of 3.942 million tons in 2011, or rather, 3.2% higher than the rate of the previous year. Brazil is actually first rank in the exportation of broiler meat, with 40.2% of exports in the sector. The country's revenue from poultry meat

exports in 2011 reached US\$ 8.253 billion, with a 21.2% rise when compared to that in 2010 (Ubabef, 2012).

The efficiency of the poultry production system in developed countries caused a drop in prices and the replacement of bovine meat by chicken meat. Increase in the product's consumption in Brazil transformed the poultry industry into a dynamic and competitive sector (Carvalho *et al.*, 2008). Consequently, consumers became more demanding with regard to quality and safety of the product (Bueno *et al.*, 2007). Per capita consumption of chicken meat by Brazilians in 2011 reached 47.4 k, with a 7.5% growth when compared to rate in 2010, with a consumption of 44 k (Ubabef, 2012). Carcass processing, foregrounded on hygiene, sanitary and economical aspects, is a basic requirement so that Brazil may continue current internal and external consumption. Special care during processing should be taken with regard to the amount of water retained in chicken carcasses to avoid excessive absorption and thus affects the final product (Fante *et al.*, 2008). The Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA) ruled on the Technological, Hygiene and Sanitary Inspection of poultry meat through Ordinance 210, published on the 10th November 1998. Strict criteria were established for the poultry industry as from reception to the final product so that the products quality and harmlessness could be warranted. Water

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absorption percentage by chicken carcasses could be determined by two methods. The drip test, performed in official and registered laboratories, determine water rates of frozen chickens, with an allowance of 6% water (Brasil, 1998).

The Internal Control Method comprises water absorbed during pre-cooling by immersion and is directly related to the coolers water temperature, permanence time in the system, type of abdominal cut and bubbling intensity. It is based on the comparison of duly identified carcass weight and weight after pre-cooling by immersion. The quantity of water determined by this method is given in percentage of total weight of poultry carcass up to a maximum of 6% of its weight (Brasil, 1998).

Through the Brazilian Department of Inspection of Animal Products, MAPA modified the Program for the Prevention and Control of Water Addition in products. It published Ordinance 38 of 2010 and updated procedures for the control of water absorption in poultry carcasses. The industries had to forward written programs describing controls that would prevent possible operational flaws and avoid frauds (Brasil, 2010a).

The Brazilian state of Bahia currently has nine poultry and rabbit slaughterhouses, under the control of the Federal Inspection Service (SIF) and seven under the State Inspection Service (SIE). Due to the growth in chicken abattoirs inspected by the State government, the ADAB intensified control, especially with regard to economic frauds and undertook periodical official analyses of meat in independent laboratories and in others in the industries proper. Current analysis aims at validating the efficiency of the sampling plan of the Drip Test in frozen broiler carcasses according to Ordinance 210/1998 of MAPA.

MATERIALS AND METHODS

Study area and characterization of the abattoir: Assay was conducted in a poultry abattoir in the area of the Bahia Reconcavo under the control of the state inspection service. The abattoir has a capacity for fifty thousand chickens per day and is included in the Brazilian Inspection System (SISBI) of the Unified System for Agricultural and Breeding Health Care (SUASA), according to Ordinance 210 of November 1998 (Brasil, 1998) on chicken technological processing.

The industry where the assay took place has two apparatuses for carcass cooling: a pre-chiller and a chiller equipment, made of stainless steel 304, thickness 2 mm, respectively 6m and 9m long.

Ice is introduced in the cooling equipment by a 7 cm long galvanized ice screw and a 5 cv gear-motor. Further, 750 kg of ice are introduced into the pre-chiller tank every 20 min. Since the abattoir's hour load reaches 530 min, total ice per day is 20.250 kg. In the case of the chiller tank, there is an addition of 3.200 kg

from the discharge of ice load at every 5 min. Total ice in the second equipment reaches 23.450 kg.

The warm bath for the Drip Test, trademark SILVEIRA, is made of stainless steel AISI 304 and provided with a water heating system by electrical resistance so that a temperature of 42±2°C could be maintained. Scale, trademark SPEED WEIGH, weighs carcasses up to 10kg.

Collection of samples and procedures: The industry's operational flowchart identified chicken carcass batches per truck, with a truck per batch. Assay was divided into two simultaneous phases (A and B) which included the internal control method (A) and the Drip Test (B). Control of water absorption index by poultry carcasses under pre-chilling by immersion in water was determined by methodology according to Ordinance 210/98 Ministry of Agriculture, Livestock and Food Supply for both phases. Internal Control Method comprised 105 samples with 10 chickens each, totaling 1050 chickens and distributed according to Table 1. After the identification of batch, chicken carcasses were packed and frozen for at least 24 h.

The products were stored in freezing chambers according to processing batch (or truck) for easy identification. Collection of samples for the Drip Test followed batch analyzed the previous day by the Internal Control Method.

Samples of frozen chicken were collected at random in the abattoirs freezing chamber, labeled and distributed (Table 2). Ninety samples with 12 chickens each were collected, totaling 1080 analyses and processed between September 2011 and February 2012.

Percentage of liquid loss was calculated by the following formula: $(M0-M1-M2) \times 100 / M0-M1-M3$, where M0 is the weight of the frozen carcass; M1 is the weight of the first package; M2 is the weight of the thawed carcass, package and giblets, if any; M3 is the weight of the giblets (if any) package. Carcass, viscera and packages were dried prior to weighing.

Table 1: No. of collected samples/month for internal control method

Month	Total
September 2011	12
October 2011	15
November 2011	21
December 2011	20
January 2012	22
February 2012	15
General Total	105

Table 2: No. of collected samples per month for the drip test

Month	Total
September 2011	11
October 2011	15
November 2011	21
December 2011	20
January 2012	22
February 2012	01
General Total	90

Average from the six samples randomly collected is standard, following official methodology described by Ordinance 210 (Brasil, 1998). Test is the mean of 12 randomly collected samples simultaneously as the standard samples, doubling the number of collections. Result average was calculated by adding and dividing by six in the case of standard and by 12 in the case of test. Difference of each sample was calculated by subtracting the result of the standard mean by mean test.

So that the randomness of the standard samples could be guaranteed, drawing of the results of the test samples was performed in each day of analysis.

Structural analysis: Descriptive and analytic analysis of data was performed with Statistical Package for the Social Sciences (SPSS 13.0), with distribution and frequency of information by the measurement of central and biased trends and their attributes.

RESULTS AND DISCUSSION

Increase in chicken meat consumption during the last decade directly affected consumers’ defense organs (Sá *et al.*, 2007). Water inclusion is a type of economic fraud common in Brazil and in other countries and may be masked by the freezing process (Pavim and França, 2011).

Brazilian law makes mandatory the application of the Drip Test to evaluate the wetness rate absorbed by chicken carcass during processing. Test is conducted on frozen products and should comply with official parameters with a 6% limit (Brasil, 1998, 2010a). The Internal Control Method, obtained by evaluating carcasses before and after the cooling process, analyzes the water quantity in cooled carcasses (Brasil, 1998).

In Phase A of current investigation, which deals with absorption control by the Internal Control Method, all 105 analyses provided results below the average 6% limit by MAPA for chickens (Fig. 1). Absorption percentage varied between 4.2 and 7.5% with daily production of 3110 to 36951 chickens during the period. Average weight of broilers varied between 1930 g and 2736 g and the slaughter speed varied between 3000 and 3600 chickens per hour.

In Phase B, average 6.7%, obtained from six samples, exceeded the limit by MAPA (Fig. 2). Mean results from 90 samples had an absorption variation between 4.07 and 7.10% by the Drip Test.

Santos *et al.* (2009) reported that hydration index of broiler carcasses of three firms in the state of Minas Gerais, Brazil, caused great liabilities for consumers. This was especially true in the case of two firms which registered between 24.24 and 28.69% of water in frozen broiler carcasses. Two hundred and forty (22%) out of 1080 broiler carcasses analyzed by the Drip Test in current assay registered an absorption index above 6%. Data corroborate analysis by Nascimento (2010) who stated that, although average of the six samples was normal, carcasses had a 30% excess of water when individually analyzed.

Results (Fig. 3) showed that there is no considerable difference between the average from the standard sample of six carcasses and the test sample with 12 carcasses. It has been reported that all results were within the limits of 6% proposed by law in the study with double the number of samples. Mean of test sample varied between 4.34 and 5.99%. Differences between the result averages varied between -0.72 and 1.11 or rather, 51 samples with standard results less than that of the test; one sample without any difference between

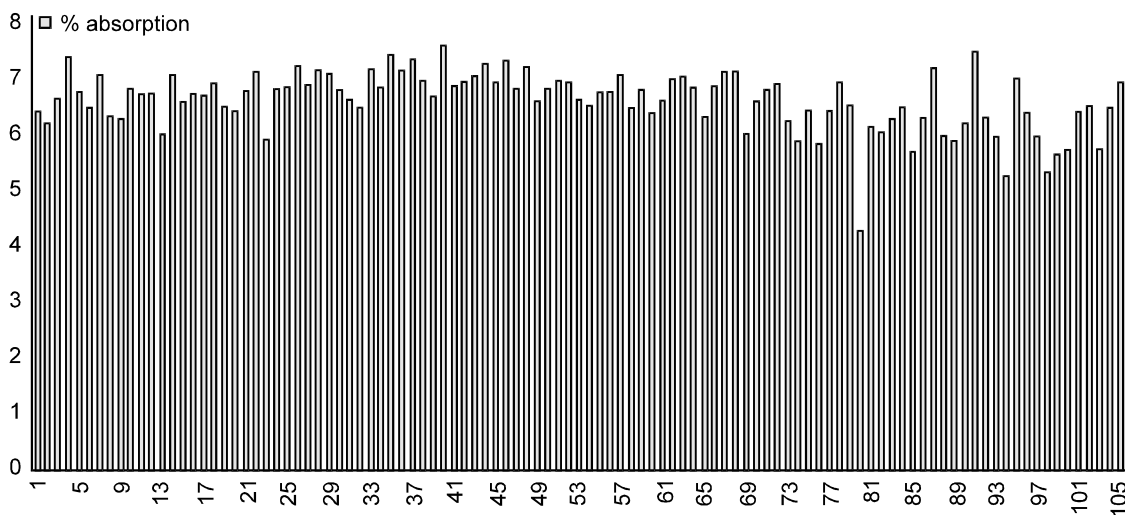


Fig. 1: Absorption control in percentage, taking into consideration legal requirement (max. 6%) between Sep. 2011 and Feb. 2012

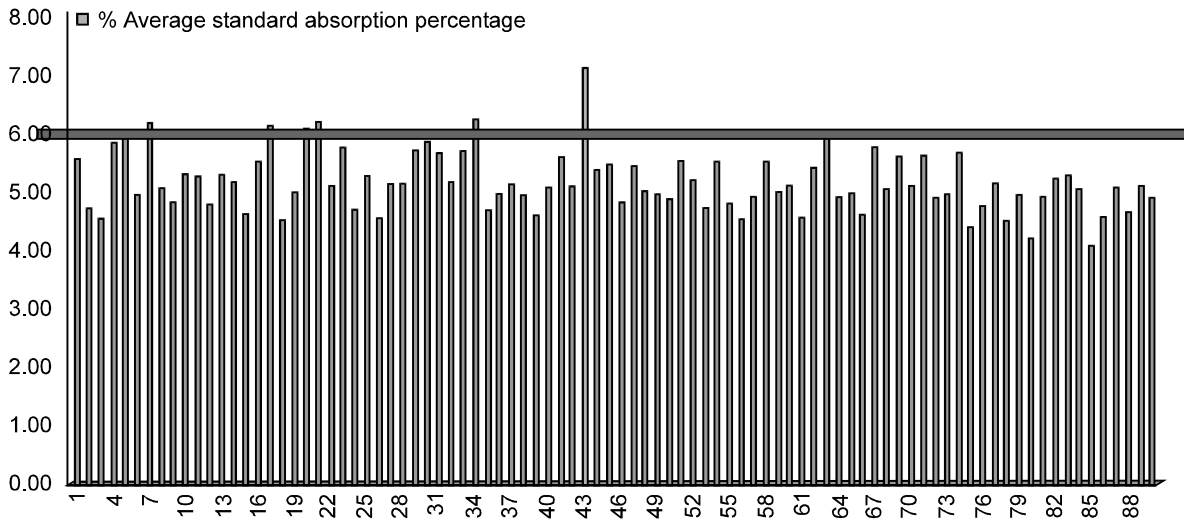


Fig. 2: Result of Drip Test obtained from standard average of six samples, taking into account the legal requirements (max. 6%) between Sep. 2011 and Feb. 2012

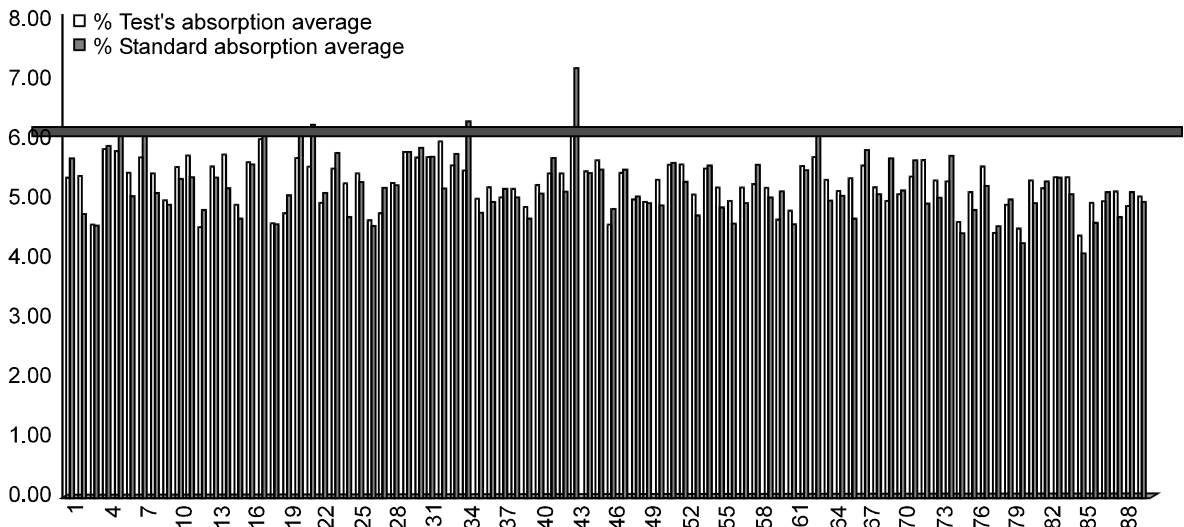


Fig. 3: Result of Drip Test comparing the test's absorption average with 12 samples and standard with 6 samples, taking into consideration legal requirements (max. 6%), between Sep. 2011 and Feb. 2012

test results and standard ones; 38 samples with results in which standard results were higher than test results.

Fante *et al.* (2008) analyzed three different trademarks of frozen broiler carcasses from supermarkets in a town in the state of Mato Grosso, Brazil. Thirty samples of trademarks A, B and C were thawed in a refrigerator: they were placed on a grid with the pierced plastic bag for the water to run out. Water absorption was calculated by the differences in weight of the frozen samples and their weight after thawing. Results showed an absorption rate of up to 28.29% of water in trademark B. Fig. 3 underscores a carcass which had a 12.81% index and thus raised the average of the six carcasses to

7.1%. According to Carciofi (2005), the carcasses scanty mobility in the chiller may affect water absorption. The permanence of broiler carcasses at different depths causes differences in the water percentage absorbed. The above study showed that permanence time in the chiller may have great variations. Identified carcasses which were simultaneously chilled had a retention time with up to 25% difference. During carcass transport by worm thread, it is not uncommon that carcasses remain in stagnated or fixed spots within the equipment. Further, the worm thread does not have the same contact on all carcasses and some may be transported faster through the chilling system.

According to Young and Smith (2004), the elimination of 4.72% out of 11.7% absorbed water during the chilling of carcasses in the immersion tank occurs within 24 h of storage.

Methodology of the Drip Test described by MAPA determines a minimum period of 65 minutes for immersion in water at 42±2°C for carcasses up to 800 g. Above this weight, 7 min more are required for each 100 g, during the warm bath. Table 3 shows that immersion time varied between 119 and 217 min.

Sousa *et al.* (2005) developed an experiment to evaluate unfreezing methodology by microwaves, especially with regard to time saving. The study evaluated 60 carcasses, or rather, 30 were thawed by the official method and 30 by the microwave test. The authors proved the feasibility of the equipment when compared to the official test, especially with a significant decrease in thawing time, or rather, 8 minutes for all carcasses tested.

The abattoir in which current study was developed complies with technological standards and control parameters that interfere in the water absorption by carcasses, such as correct temperatures in the pre-chiller and chiller apparatuses; constant renewal of water in the correct proportion and counter-clockwise to the movement of carcass and giblets; hyperchloration control of renewal water of the system within the parameters recommended and maximum permanence time in the equipment. Results ratify control when the Drip Test with an average of 6 carcasses was not observed and unsatisfactory indexes were obtained.

Several investigations show irregularities with regard to water rate in carcasses of frozen broilers. In Pasqualetto *et al.* (2001) analyzed 84 samples collected from the state of Goiás, Mato Grosso do Sul and the Federal District, Brazil and verified that 78.57% were outside the established limits. Based on research in Campo Grande by Negrini *et al.* (2007), the index reached 6.82% of the carcasses gross weight.

Further, Sa *et al.* (2007) concluded that 50% of frozen chickens collected in big retailing stores in Uberlândia MG Brazil, had 11.32% of water and thus were outside the limits set by legislation.

Gomes and Azeredo (2009) analyzed in Rio de Janeiro 47 samples with 6 frozen chickens each by the official method and found that 68% were above the 6% limit, with indexes varying between 3.48 and 23.51%. They also verified that 7 samples had water rates over 10%.

Studies by the technical team of the Brazilian Institute for the Defense of the Consumer (IDEC) on eight trademarks of frozen chicken showed irregularities in seven. This boils down to 87.5%, with rates varying between 6.6 and 11.9% of water absorption by carcasses. The study also demonstrated liabilities per family due to water addition. Costs may reach up to R\$ 34.95/year (Ponçano *et al.*, 2008).

Table 3: Relationship of immersion time in warm bath at 42±2°C, according to weight of broiler carcass, according to legal requirements

Weight of carcasses (g)	Quantity of carcasses	Immersion time in min
1.501-1.600	04	119
1.601-1.700	31	126
1.701-1.800	98	133
1.801-1.900	151	140
1.901-2.000	200	147
2.001-2.100	227	154
2.101-2.200	202	161
2.201-2.300	90	168
2.301-2.400	51	175
2.401-2.500	17	182
2.501-2.600	02	189
2.601-2.700	05	196
2.701-2.800	01	203
2.901-3.000	01	217

A study was recently published in which 76.66% of 30 chicken carcasses of different trademarks and collected in retail store had water percentage above the limits proposed by Brazilian legislation, or rather, an average of 7.69±3.52%. Thawing index varied between 2.6 and 18.24%. In one trademark tested, the consumer had a loss of R\$ 0.24/k of chicken (Coelho *et al.*, 2011).

According to the Department for the Inspection of Animal Products (DIPOA) of the Ministry of Agriculture, 77 firms were fined between 2006 and 2008 because their products exceeded the limit of water absorption. Abattoirs from the state of Parana, Brazil, were the most fined, featuring 21 firms (28% of total); followed by those in the states of São Paulo (19 abattoirs), Rio Grande do Sul (11), Santa Catarina (8), Goiás (4), Minas Gerais (4), Mato Grosso do Sul (3), Distrito Federal (2), Mato Grosso (2), Pernambuco (2) and an abattoir from Bahia (Avisite, 2008).

The Secretary for Justice, Citizenship and Human Rights (SJCDH), through the Superintendence for the Protection of Consumers, recommended that the state of Bahia should be wary of frozen chicken packed in other states (Bahia, 2008).

Due to many irregularities, DIPOA made it mandatory that abattoirs should undertake the test at least during one slaughter shift with control described in the program for the Prevention and Control of Water Addition to products (Brasil, 2010a). In specific situations, or rather, when there are indications that the product does not meet the specific standards set by legislation, the firm should be submitted to the Special Control Regime (Brasil, 2010b).

Abattoirs registered at SIE of the state of Bahia, Brazil, slaughtered some 36,224,820 chickens in 2011, a development of 120% since 2006. These rates go beyond the number of slaughters inspected by the state's SIF (Bahia, 2012a). The participation of chickens slaughter in Bahia is ninth in Brazilian ranking (Ubabef, 2012).

In 2011, through the Laboratory of Animal Nutrition, ADAB intensified control on the broiler industries inspected by SIE. Thirty tests were undertaken on frozen chickens from 7 abattoirs. Results showed that 20 firms complied with legislation, whereas 10 failed to do so, with rates varying between 6.2 and 9.89%. During the first three months of 2012, only 2 out of 12 analyses were above the 6% limit. This fact shows a significant decrease in irregularities in the state (Bahia, 2012b).

Conclusion: Since no significant difference exists when the Drip Test is performed with an average of 12 carcasses, the fact validates the sample plan proposed by MAPA through the Ordinance 210/98 obtained by an average of 6 carcasses.

Sanitary Inspection Service is crucial for the control of water absorption in broiler processing so that economic frauds and liabilities to consumers could be avoided.

ACKNOWLEDGEMENTS

The authors would like to thank AVIGRO and its quality control team for the support given during the six months spent to perform current investigation.

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