ALTERNATIVE ASSESSMENT OF RAW BROILER MEAT FRESHNESS

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Abstract

Poultry meat, especially the broiler meat, is required by Romanian consumers. Therefore it is important to assess the raw broiler meat freshness quickly, without expecting the results of microbiological tests which sometimes can take two or more days. We determined the biogenic amines content for refrigerated raw broiler carcasses and skin in order to calculate the freshness index. Biogenic amines (putrescine, cadaverine, histamine, spermine and spermidine) were analyzed during 20 days of refrigerated storage. In the first day of storage the content of putrescin, cadaverine and histamine were under 4 mg / kg d. w. for broiler carcasses and skin. Also, broiler carcasses had the highest value of spermine, the broiler skin being lower with 27.85 %. Cadaverine and putrescin had an increase of value throughout the carcasses storage period. Both spermine and spermidine show a decrease during the broiler carcasses storage. The freshness index calculated with mathematical formula proposed by Mietz and Karmas [(putrescin + cadaverine + histamine / 1 + spermine + spermidine)] show an initial value for broiler carcass of 0,06 and for broiler skin of 0.41. The highest value for the considered freshness index was with 21.8 % higher for broiler skin than for broiler carcass, at the 20th day of refrigerated storage. We used the easily hydrolysable nitrogen for comparing the degree of spoilage made by microorganism for broiler carcass and skin. The initial amount of easily hydrolysable nitrogen for broiler skin were 23 mg / 100 g, being with 10.86 % higher than the amount for broiler carcass. In the last day of storage, the amount of easily hydrolysable nitrogen for broiler skin was two times higher than the value of broiler carcass.

Key words: chicken meat, refrigerated storage, freshness index, spoilage, biogenic amines.

The refrigerated chicken meat spoilage when stored for a long period is due to the microorganism action and the biochemical transformations inside the product. After chicken slaughter, the muscular tissue suffers irreversible physical, chemical and biochemical transformations that determine the muscle to convert in meat. The microbial spoilage processes occurs later. Using refrigeration temperatures for meat conservation purpose reduces microorganism activity.. For the identification of the early signs of meat alteration, some chemical indices were proposed: volatile nitrogen basis, composites resulted after breaking the nucleotides, volatile acidity and the biogenic amine content (Halasz *et al.*, 1994). During storage, in meat and meat products it may develop highly toxic substances such as ammonia, hydrogen sulphide, peroxidase, and biogenic amine that can appear because decarboxylation of amino acids in meat. The biogenic amine occurrence is a consequence of the enzymatic decarboxylation of the precursor amino acids because of the microorganism activities. Polyamines: spermine and spermidine are natural amines produced by the body. The biogenic amines putrescin, cadaverine, histamine, can be formed due to microorganism action. The biogenic amine determination is important not only because of their toxicity but also their potential use as freshness indicators (Balamatsia *et al.*, 2006).

Different authors' studies regarding the refrigerated chicken meat showed that some of the previously mentioned biogenic amine concentrations are increasing in time, while others are decreasing during storage (Vinci and Antonelli, 2002, Apostolos *et al.*, 2006, Sarinen *et al.*, 2002, Balamatsia *et al.*, 2006, 2007). From a practical point of view, the relative simplicity and quickness identification and quantification of the biogenic amines (compared to the micro-biological measurement) are reasons for using these substances as chemical indices for broiler meat freshness. Easily hydrolysable nitrogen can be use for the identification of the first signs of broiler meat alteration (Halasz *et al.*, 1994).

Our objective is the evaluation of refrigerated broiler meat and skin quality using biogenic amines and easily hydrolysable nitrogen, and to calculate a freshness index based on the formula proposed by Mietz and Karmas (Mietz, J.L. and Karmas, E., 1977).

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MATERIALS AND METHODS

The refrigerated broiler carcasses were purchased from a Romanian company slaughterhouse. The meat was analyzed after cooling, packaging and transportation from the plant beginning with the first day after slaughter. The carcasses were stored aerobically for 20 days at a temperature of 4±1°C in the Electrolux ENB43691S refrigerator. The carcasses weight varied between 1.2÷1.5 kg. Sampling was done as per Romanian Recommendation Norm 24/01/2005 (***, 2005). The samples were analyzed in the first day when the meat was received, recorded as day 1, then the 3rd, 5th, 7th, 13th, and 20th day. The dry matter determination was done according to STAS 9065/3 - 73. The easily hydrolysable nitrogen was determined according with STAS 9065/7 - 74.

The determination of biogenic amines amount using high performance liquid chromatography was performed according to the method proposed by Food Research Institute from Helsinki, Finland (Eerola *et al.*, 2001) and described in Baston (Baston *et al.*, 2008). The reagents were chromatographic an analytical grade. The concentration of each biogenic amine was expressed in mg/kg d.w.

The statistical analysis of the obtained data was done using SPSS 13 software for 10 samples in each of the storage days. The results obtained are presented as the mean ± standard deviation. The differences among means were determined using the method of the smallest squares and the significance level was $p< 0.05$.

RESULTS AND DISCUSSIONS

Biogenic amines variation for refrigerated broiler carcasses meat and skin are presented in figure 1 and 2.

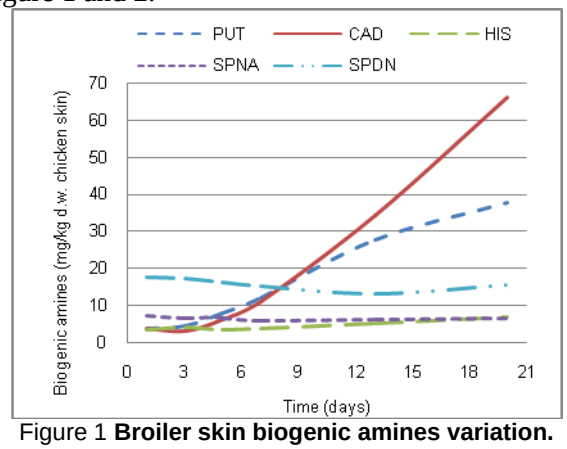

Figure 1 **Broiler skin biogenic amines variation.** (PUT-putrescin, CAD-cadaverine, HIS-histamine, SPNA-spermine, SPDN-spermidine).

In figure 1 the highest initial content of biogenic amine had spermidine followed by spermine. In the first day of analysis the lowest content had cadaverine, histamine and putrescin. Cadaverine and putrescin had an increased value along the refrigerated broiler storage period, in the last day of storage; the cadaverine showed the highest amount of all the studied amines (66.23 mg/kg d.w.). Spermidine had a decreasing value along the storage period of broiler skin, also the spermine. Histamine showed a moderate increase along the refrigerated skin storage period.

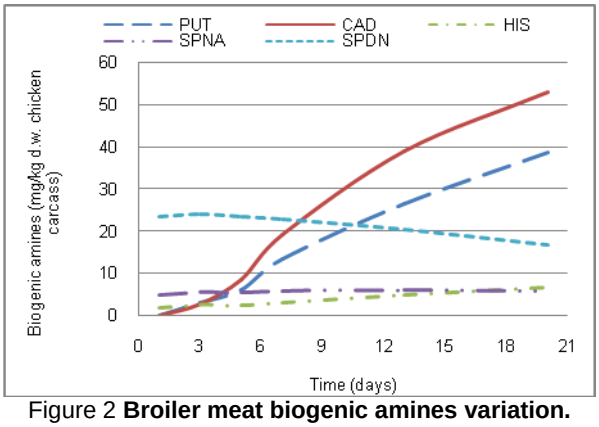

Figure 2 **Broiler meat biogenic amines variation.**

Refrigerated chicken meat from broiler carcasses had an initial cadaverine and putrescin amount not detected. Begining with the third day of storage, the amount of the two amines were comparable with the ones found in the first day of analysis of the broiler skin. Likewise to broiler skin, the highest amount from all the biogenic amines studied, in the last day of storage, had the cadaverine (52.98 mg/kg d.w.). It was followed by putrescin (38.84 mg/kg d.w.). Also, spermidine, from all the biogenic amines studied, had the highest initial amount (23.51 mg/kg d.w.) and followed by spermine. In the first day of storage, histamine was found, and its value was small (1.86 mg/kg d.w.).

Apostolos found for precooked chicken meat product an initial concentration for putrescin 0.8 mg/kg, for cadaverine 0.2 mg/kg, for spermine 11.5 mg/kg, for spermidine 188 mg/kg and for histamine 1.9 mg/kg. Until the 23th day of refrigeration at 4°C, the putrescin conentration increased to 202.6 mg/kg, the cadaverine increased to 14.8 mg/kg, the spermine increased to 29.7 mg/kg, the spermidine decreased to 66.7 mg/kg and the histamine increased to 25.1 mg/kg (Apostolos *et al.*, 2006).

Balamatsia stored the fresh chicken breasts at 4°C in air and determined an initial amount of putrescine 58.3 mg/kg, cadaverine 19.8 mg/kg, spermine 53.3 mg/kg, spermidine 7.9 mg/kg and histamine was not detected. At the 17th day of storage, the biogenic amines concentrations were for putrescin 409.6 mg/kg, cadaverine 252.7 mg/kg spermine 36.6 mg/kg, spermidine 4.8 mg/kg and histamine 19.2 mg/kg. In this case, histamine was

not detected until the eight day of storage (Balamatsia *et al.*, 2006).

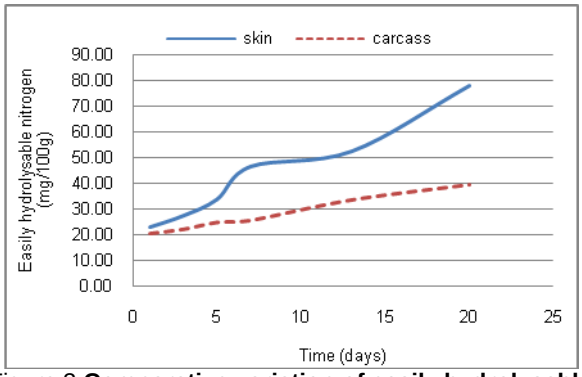

Figure 3 **Comparative variation of easily hydrolysable nitrogen.**

The easily hydrolysable nitrogen determination purpose was to determine the ammonia quantity that is formed in the broiler meat and skin after protein degradation by the spoilage microorganism's activities. For chicken meat, the Romanian Recommendation Norm imposes a limit of freshness of 25 mg NH_3/100 g. Unfortunately for chicken skin there are no limitations. In the first day of storage, the meat had a slightly lower value for easily hydrolysable nitrogen than the skin. Once the time is passing, at the refrigerated storage, the skin amount of easily hydrolysable nitrogen is increasing more, comparative with the amount found for broiler meat. The limit imposed by Romanian legislation for meat freshness was exceeded beginning with the fifth day of refrigerated storage. In the last day of storage, the amount found for refrigerated broiler meat was of 39.68 mg/100 g, and for skin of 78.2 mg/100 g.

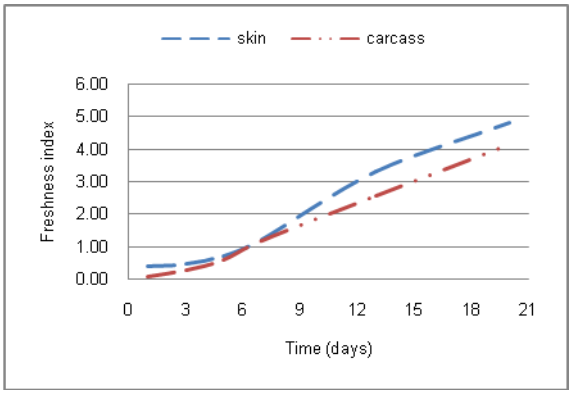

Figure 4 **Mietz and Karmas freshness index variation for refrigerated broiler skin and meat.**

Based on the mathematical formula proposed by Mietz and Karmas: [(putrescin + cadaverine + histamine / 1 + spermine + spermidine)], we accomplished the variation diagram (figure 4) for the freshness index (FI). In the first day of storage, the values of FI are different, being with 85.36% higher for broiler skin. At the seventh day of storage, the FI value for skin and meat is 1.20. The authors proposed for fish meat (canned tuna fish) a freshness limit of 1. After that value, the fish meat enters into an initial breakdown that represents an initial alteration of the meat.

Making a correlation between the easily hydrolysable nitrogen value when the broiler meat exceeds the imposed limit (the fifth day of storage) and the FI calculated with the mathematical formula, we can say that only for chicken meat the FI have a value of 0.58. Unfortunately, for the broiler meat and skin, the limits imposed by Mietz and Karmas cannot be realistic. Studies need to be done and also correlations between some phisico-chemical parameters that characterize the chicken meat freshness and biogenic amines content for determining maybe a mathematical formula for FI.

Because of the upward shape of the FI variation, we can say that the studied mathematical relation is not suited for freshness, but for spoiling, because the loss of freshness indicates that the meat starts to spoil. In any case, when a product starts to lose the freshness, as for refrigerated broiler skin and meat, the freshness index is not increasing, but is decreasing in time.

CONCLUSIONS

Biogenic amines: putrescin, cadaverine, histamine, spermine and spermidine can be used for refrigerated broiler meat freshness determination. Mathematical formula proposed by Mietz and Karmas can be used as a spoilage index.

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