STUDY CONCERNING THE QUALITY OF POULTRY LIVER STORED IN REFRIGERATION CONDITIONS

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Abstract

The freshness state is one of the most important features when we talk about food quality. It is important t know when a food is fresh in the storeas well as at home. This is why we aim to study the stability over the time of the indicators defining the quality of the bird's liver and the identification of the threshold in which the liver undergoing refrigeration process loses its freshness and passes to the stage of alteration. Thus, investigations were carried out on poultry liver packaged in polystyrene trays and stretch film and stored in a household refrigerator for 9 days at +3°C. In each day of storage, 5 packing units were opened from which samples were collected to assess the qualiative changes.
The dynamic analysis of the pH of the analyzed liver highlighted slight increases in value that went along with the aging of the product. By correlating the values obtained with the maximum limit imposed by the existing legislation (25 mg NH_3/100g), it can be observed that by the 6th day of storage, the average values of the ammomnium nitrogen content indicated a good product for consumption. The results obtained on the presence of hydrogen sulfide and the oxidation of fats, indicate that the chicken liver has maintained its freshness for 5 days of storage. The dynamic microbial load from the broiler chicken liver within the 9th day period shows a significant upward trend, both with respect the TNG and the number of germs from the genus Enterobacteriaceae, but variations in microbiological parameters fall within tolerance limits specified for them.
Based on the determinations made and considering the limits imposed by the existing standards, we can see that the 5th day of storage is the maximum limit of the validation for the poultry liver.

Key words: broiler, liver, refrigeration, freshness.

Meat and meat products represent an important part of human food because those provide essential nutrients that can not be easily obtained through vegetables and derived products (Byers A. et al, 2002).

In the past years, there has been a growing trend in the marketing of fresh chilled meat products due to their characteristics, namely: the image of "fresh meat", "healthy meat", ease of culinary preparation, and varied ways of cooking (Baston O., 2010).

The freshness state is one of the most important features of the total food quality. It is important to know when a food is fresh in the store as well as at home. That is why we aim to study the stability over time of the indicators defining the quality of the birds's liver and, respectively to identify the threshold in which the liver undergoing the refrigeration process loses its freshness and goes into a stage of alteration.

MATERIAL AND METHOD

The studied sample consisted of liver samples purchased from a regional producer obtained from „Ross 308" chickens saughtered at the age of 42 days.

Liver samples were analyzed on the day of preparation, before being subjected to the refrigeration (recorded as day 0), and in order to assess the stabilty of the liver during storage, it was agreed that the liver under study was packaged in polystyrene trays and strech film and stored in a household refrigerator for 9 days at +3°C.

At the end of the first day of storage, 5 packing units were opened from which samples were collected to assess the quantitative changes of the package. The procedure was repeated on a daily basis until the 9th day of storage to track qualitative changes in the liver and after the expiry date specified by the manufacturer (maximum 6 days).

The alteration of the refrigerated chicken liver stored for a long time is due to the action of microorganisms and biochemical transformations that take place inside it.

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The daily quailty of chilled liver was evaluated using physicochemical indicators (pH value, easily hydrolysable nitrogen, hydrogen sulfide, Kreis reaction) and microbiological (total number of germs (TNG), *Enterobacteriaceae*).

The pH value was measured using a standardized method (SR ISO 2917:2007) with an InoLab laboratory pH meter, and the easily hydrolysable nitrogen was determined according to SR 9065-7:2007. The presence of hydrogen sulfide has been established on the basis of the lead acetate test (resulting from the combination of lead acetate and hydrogen sulphide results in a black-and-white sulfide) (SR 9065-11:2007). The assessment of the fat oxidation stage was performed by the method specified by SR 9065-10:2007.

Bacteriological criteria were analyzed as follows: TNG was determined on a standard plate, the medium PCA at 37°C for 72 hours (SR ISO 4833-1:2003), and the number of *Enterobacteriaceae* was determined on medium VRBG for 24 hours at 37°C (SR ISO 21528-2:2007).

The obtained data were subjected to some statistical calculations, using ANOVA algorithm included in MsExcel.

RESULTS AND DISCUSSION

The pH value affects the quality of a product, conditioning its sensory, hygienic and technological attributes.

A key factor in the use of liver in the production of meat products is the pH value. It can play a positive role in the formation of the paste if it has pH values close to 6.0 (Ramirez-Suárez J. and Xiong Y., 2003); the optimum pH value for the formation of a good paste was found to be 6.3 (Lesiow T. and Xiong Y.L., 2003).

The dynamic analysis of the pH of the analyzed liver highlighted increased values that went along with the aging of the product.

If in the case of liver samples stored for one day under refrigeration conditions, the mean value of the pH was 6.19±0.004, on the 6th of control (the expiration date set by the manufacturer) it reached an average value of 6.84±0.020, whereas on 9th day it had the value of 7.22±0.006.

Regarding the value of the coefficient of variation for each control step, it can be mentioned that it was presented as a very homogenous character (V%<10) (table 1).

Table 1

The dynamics of physico-chemical indicators of poultry liver

Storage life (days)	pH value		Easily hydrolysable nitrogen ($mgNH_3/100g$)	
	$\bar{X} \pm s_{\bar{x}}$	V%	$\bar{X} \pm s_{\bar{x}}$	V%
0	6.18±0.005	0.177	11.59±0.134	2.586
1	6.19±0.004	0.135	11.78±0.100	1.892
2	6.25±0.011	0.408	13.87±0.083	1.338
3	6.36±0.004	0.141	15.37±0.206	2.992
4	6.40±0.012	0.422	16.80±0.108	1.444
5	6.59±0.009	0.320	18.81±0.080	0.952
6	6.84±0.020	0.640	21.49±0.147	1.530
7	7.04±0.010	0.308	25.37±0.170	1.495
8	7.16±0.009	0.289	26.23±0.191	1.626
9	7.22±0.006	0.181	28.28±0.146	1.154

Regarding the easily hydrolysable nitrogen content of poultry liver, a quantitative increase during storage under refrigeration conditions can be observed from the data resulted (table 1).

By correlating the values resulted with the maximum limit imposed by the existing legislation (***2002) of 25 $mgNH_3/100g$ it can be seen that by the 6th day of storage, the mean values of ammonium nitrogen content indicated a good product for consumption; on the 7th day control, the upper limit of easily hydrolysable nitrogen content was exceeded (as a result of triggering the alteration process), recording the value of 25.37±0.170 $mgNH_3/100g$. At the end of the experiment (9th day), the easily hydorlysable nitrogen showed an average level of 28.28±0.146 $mgNH_3/100g$. The calculated values for the coefficient of varation were in the range of 0.952–2.992%, which indicates a uniformity of character over the enitre control period.

The resulted data regarding the existence of hydrogen sulfide, indicates the fact that the chicken liver has maintained its freshness for 5 days of storage. The 6th day of refrigeration storage marks the beginning of the biological processes of alteration, with the release of hydrogen sulfide (2 slightly positive samples out of 5).

This process increased in intensity from the 8th day of storage when the H_2S identification reaction was strongly positive (4 samples out of 5) (table 2).

Table 2

Identification of the presence of hydrogen sulfide in poultry liver

Sample	Storage life (days)									
	0	1	2	3	4	5	6	7	8	9
1	-	-	-	-	-	-	-	±	±	+
2	-	-	-	-	-	-	-	±	+	+
3	-	-	-	-	-	-	±	±	+	+
4	-	-	-	-	-	-	-	±	+	+
5	-	-	-	-	-	-	±	±	+	+

- = absence; ± = easily existent; + = strongly existing

The fatty analysis showed us that samples stored at +3°C were kept fresh within the first 5 days. At the 6th and 7th day control, the first discrete signs of rancidity (the appearance of a pale pink color) were found; starting with the 8th day, the signs of alteration became more and more obvious (the appearance of the red-violet color) (table 3).

Table 3

Identification of aldehydes in poultry liver

Sample	Storage life (days)									
	0	1	2	3	4	5	6	7	8	9
1	-	-	-	-	-	-	±	±	+	+
2	-	-	-	-	-	-	±	±	+	+
3	-	-	-	-	-	-	-	±	±	+
4	-	-	-	-	-	-	±	±	+	+
5	-	-	-	-	-	-	±	±	+	+

- = white or yellowish tint; ± = pink-red color; + = red-purple color

The analysis made by Preda C.V. et. al (2012) under similar experimental conditions, showed that the bird's liver kept its freshness until control on the 7th da, at which time the Kreis reaction was poorly positive.

The dynamic analysis of the bird's liver of the TNG revealed an increase from one control stage to another, but it is intereseting that both the temperature and the storage life did not have a major influence on this dynamics. Thus, if the microbiological control performed on day 1 recorded a value of 3.37±0.003 $\log_{10}$cfu/g, at the control on the last day of validity (day 6) it reached a level of 3.439±0.008 $\log_{10}$cfu/g, whereas at the last control (day 9), the mean number of aerobic mesophilic germs was 3.66±0.008 $\log_{10}$cfu/g.

Table 4

The dynamics of microbiological indicators of poultry liver

Storage life (days)	TNG ($\log_{10}$cfu/g)		*Enterobacteriaceae* ($\log_{10}$cfu/g)	
	$\bar{X} \pm s_{\bar{x}}$	V%	$\bar{X} \pm s_{\bar{x}}$	V%
0	3.366±0.004	0.307	1.586±0.005	0.813
1	3.371±0.003	0.250	1.597±0.005	0.790
2	3.380±0.003	0.232	1.680±0.027	3.612
3	3.382±0.002	0.171	1.723±0.044	5.737
4	3.389±0.003	0.251	1.790±0.034	4.284
5	3.407±0.007	0.498	1.837±0.051	6.291
6	3.439±0.008	0.519	1.980±0.043	4.899
7	3.507±0.007	0.507	2.138±0.054	5.684
8	3.542±0.020	0.567	2.381±0.052	4.887
9	3.666±0.008	0.524	2.613±0.046	3.987

If we consult the maximum limits stipulated by the existing legislation for this indicator, it can be stated that the liver samples corresponded from micriobiological point of view during the entire storage period, the TNG recording values below the level of 1x 10^6cfu/g (6.0 $\log_{10}$cfu/g) (***2010).

The french producers state that internal organs that are separated from the carcases have a shorter storage life than those left in the carcass, due to increased contamination during handling. According to the same authors, the storage life of the liver kept in the carcass cand be estimated 9 days after the slaughter of the birds, obtaining an TNG value of 7.0 $\log_{10}$cfu/g (ICMSF, 1996). The same value was also reported for chicken liver kept

under aerobic conditions at 4±0.5°C for 3 days (Hasapidou A. and Savvaidis I. N., 2011).

Microbiological analysis performed on the liver stored for 24 hours revealed bacteria of the genus Enterobacteriaceae, at a rate of 1.59±0.005 log_{10}cfu/g. This value increased gradually during storage, the number of bacteria of the genus Enterobacteriaceae recorded on day 6 was 1.980±0.043 log_{10}cfu/g.

CONCLUSIONS

Based on the analysis made and based on the limits imposed by the existing standards, we can see that the maximum retention time of the bird's liver at 3°C is 5 days.

The results of the study highlights the need for a constant assessment of commercially available poultry liver so that its physicochemical and microbiological indicators can be maintained at stable values for human health.

REFERENCES

Baston O., 2010. *Evaluarea prospețimii cărnii de pasăre*. Editura Stef, Iași.

Byers T., Nestle M., Mctiernan A., Doyle C., Currie-Williams A., Gansler T., Thun M., 2002. *American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention: Reducing the Risk of Cancer with Healthy Food Choices and Physical Activity*. CA Cancer J. Clin., 52:92–119.

Hasapidou A. and Savvaidis I. N., 2011. *The effects of modified atmosphere packaging, EDTA and oregano oil on the quality of chicken liver meat*. Food Research International, 9:2751-2756.

Lesiow T. and Xiong Y. L., 2003. *Chicken muscle homogenate gelation properties: effect of pH and muscle fiber type*. Meat Science, 64:399–403.

Preda Carmen Viorica, Micloșanu Elena Popescu, 2012. *Company Reaserches Regarding Time and Insurance of Shelf-Life of Carcass, Cut Pieces and Chicken Organs.* Animal Science and Biotechnologies, 45 (2):448-454.

Ramırez-Suárez J and Xiong Y., 2003. *Effect of transglutaminaseinduced cross-linking on gelation of myofibrillar/soy protein mixtures*. Meat Science, 65:899–907.

***ICMSF, 1996**. *Microorganisms in food 5: Microbiological specifications of food pathogens.* Blackie Academic and Professional, London. ISBN: 041247350X.

***SR 9065-7:2007** Meat and meat products. Determination of easily hydrolysable nitrogen content.

***SR 9065-10:2007** Meat and meat products. Determination fat oxidation degree. Kreis reaction.

***SR 9065-11:2007** Meat and meat products. Hydrogen sulphide identification.

***SR ISO 4833-1:2003** Microbiology of the food chain - Horizontal method for the enumeration of microorganisms - Part 1: Colony count at 30 degrees C by the pour plate technique.

***SR ISO 21528-2:2007** Microbiology of food and animal feeding stuffs - Horizontal methods for the detection and enumeration of Enterobacteriaceae - Part 2: Colony-count method.

***SR ISO 2917:2007** Meat and meat products. Measurement of pH. Reference method.

***2002**, Romanian Directive no. 86 from 30/08/2002 for approving the Norms regarding the chicken meatselling published in the Official Gazette, Part I no.699 from 24/09/2002, issued by the Agricultural, Alimentation and Forests Minister, of the Health and Family Minister and of the Chairman of the National Consumers Protection Authority.

***2010**, Decision of the Customs Union Commission No. 299 dated 28 May, 2010, Uniform sanitary and epidemiological and hygienic requirements for products subject to sanitary and epidemiological supervision (control) (as amended by Decisions of the Customs Union Commission N 341 of 17.08.2010, N 456 of 18.11.2010, No 622 of 7 April 2011 and N 889 of 09.12.2011).