Journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XIII, Issue 2 – 2014, pag. 122 - 126

BIOGENIC AMINE AMOUNT IN GROUND PORK AND BEEF MEAT

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Received April 26th 2014, accepted May 14th 2014

Abstract: *The biogenic amine content in ground meat is always an actual issue to be studied. Our objectives were to determine the initial amount of four biogenic amines (histamine, tyramine, serotonin and phenylethylamine) in raw ground pork and beef meat, and to determine the variation of biogenic amines along the aerobic refrigerated storage of ground meats. With the exception of serotonin, all the biogenic amines studied were under the detection limit at the first determination (day 0). All the biogenic amines accumulated in meats in time while refrigeration storage. The highest amount of biogenic amines was registered in ground beef on the last day of refrigerated storage (day 10). Histamine did not exceed 12 mg/kg in ground beef meat and 10 mg/kg in ground pork meat on the last day of storage. Tyramine was detected in both meats in lower amounts than histamine on the last day of refrigerated storage, whereas serotonin and phenylethylamine were found under 3.5 mg/kg and 2.5 mg/kg respectively.*

Key words*: amino acid decarboxilation, shelf life, consumer health, refrigerated storage.*

1. Introduction

Biogenic amines are called biologically active amines or bioactive amines because they have bio-activity in the human body. The biogenic amines occur naturally in organisms or they can be produced in fresh or processed foods by amino acids decarboxilation, aldehydes and ketones transamination or nitrogen compounds hydrolysis [1].

When fresh meat is spoiled by microorganisms, amino acid decarboxilation is the most important biogenic amines production pathway. The two most important factors for biogenic amines production in fresh foods are the food and the microorganism type. For the accumulation of biogenic amines in food, the most important factors are the existence of free amino acids and the presence of microorganisms with decarboxylasing activity.

In the scientific literature bioactive amines are considered as biogenic (histamine, serotonin, tyramine, phenylethylamine, tryptamine, putrescine, cadaverine, agmatine) and naturally occurring amines (spermine and spermidine).

Histamine is an amine that is produced in food by decarboxilation of free histidine. It is an important amine to be studied because it has toxicological effects on humans such as headaches, sweating, burning nasal secretion, facial flushing, rashes, dizziness, oedema, urticaria, difficulty in swallowing, diarrhoea, respiratory distress, bronchospasm, increased cardiac output, tachycardia, extrasystoles [2].

In fresh foods the amount of histamine should be low, under 5 mg/kg. Histamine alone at low levels does not cause toxicological effects on humans, but the presence of putrescine and cadaverine can increase the poisoning effect [3].

Tyramine is produced in food by decarboxilation of free tyrosine. It has a negative influence on human body, producing headaches, migraine, neurological disorders, nausea, vomiting, respiratory disorders, hypertension extrasystoles [2]. The toxic dose of tyramine is 100 mg/kg in normal individuals and 60 mg/kg in those under treatment with monoamine oxidase inhibitors [1].

Serotonin is produced from tryptophan which is an amino acid that is transformed by tryptophan hydroxylase into 5-hydroxytryptophan, which is enzymatically decarboxylated into 5-hydroxytryptamine or serotonin. The serotonin syndrome in humans refers to tachycardia, hypertension, and hyperthermia [4].

The free amino acid phenylalanine is decarboxilated to phenylethylamine. The biogenic amine can produce headache, migraine, increased blood pressure, being toxic to humans at 30 mg/kg. [1].

Ground meat is an important food, being used in Romanian dishes in combination with vegetables, pasta, cheese, eggs, or as meatballs. Therefore, it is used in traditional dishes such as „*mici*", „*sarmale*", „*chiftele*", „*perisoare*", or sausages, wherein the biogenic amines content of the main ingredient (ground meat) is very important for human health.

The primary goal of this study is to determine the initial amount of four biogenic amines (histamine, tyramine, serotonin and phenylethylamine) in raw pork and beef ground meat and then to determine the variation of biogenic amines during the refrigerated storage of ground meats.

2. Materials and methods

Sampling and refrigeration

Raw ground beef and pork meat were purchased directly from butcheries. All samples were put into an ice box for transportation to the laboratory. The samples were purchased from the same traders as ready to use ground fresh meat, on the production day. They were refrigerated at 4 ± 2 °C for ten days in DBK386 WD (Beko, Turkey) type refrigerator. They were analyzed every two days. The samples were stored aerobically, in plastic bags, packed after they had been purchased from butcheries. Samples for analyses were taken aseptically from the original package.

Chemical analyses

The chemical determinations were made on the same day of purchase. In total we analyzed 21 samples of ground pork meat and 19 samples of ground beef meat. The biogenic amine determinations were made in triplicates. Chemical analyses of ground meats were made from 12 samples, in triplicates.

Moisture levels were determined by air drying in the oven at 100 °C according to AOAC 950.46 method [5] using ULE 400 oven (Memmert, Germany).

The determination of biogenic amine amounts using high performance liquid chromatography was performed according to the method described in Baston [6]. The calibration curves of the biogenic amines are linear, having r^2 as follows: histamine r^2 = 0.9981; tyramine r^2 = 0.9986; serotonin r^2 = 0.9977; phenylethylamine r^2 = 0.9984.The concentration of each

biogenic amine was expressed in mg/kg dry weight.
All the reagents were chromatographically grades.

Statistical data treatment
The statistical analysis was made using Microsoft Office Excel to determine the mean and standard deviations.

3. Results and discussion

Four biogenic amines were determined: histamine, tyramine, serotonin and phenylethylamine. Figure 1 shows the histamine variation for the meats studied.

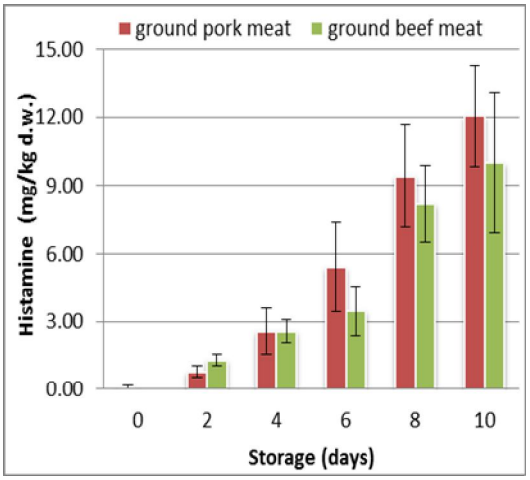

Fig. 1 Histamine variation in ground meats

The initial amount of histamine was below the detection limit of the equipment in both studied meats. On the second day of refrigerated storage the average histamine amount is smaller in ground pork meat compared with ground beef meat which is two times higher. The amount of histamine has increased for the remaining storage days, on the tenth day the average amount of ground pork meat is 12.07 mg/kg d.w., and in ground beef meat is 10.02 mg/kg d.w. Beginning with the sixth day of refrigeration, the histamine amount in ground pork meat was higher than the histamine amount found in ground beef meat. This was due to microbial transformation of the free histidine to histamine, being higher in ground pork meat.
The initial low values of histamine in ground pork and beef meat are related to the values presented by Min [7] and Vidal-Carou [8].
Tyramine is a biogenic amine also produced by microbiota of the studied meats. The variation of tyramine is presented in figure 2.

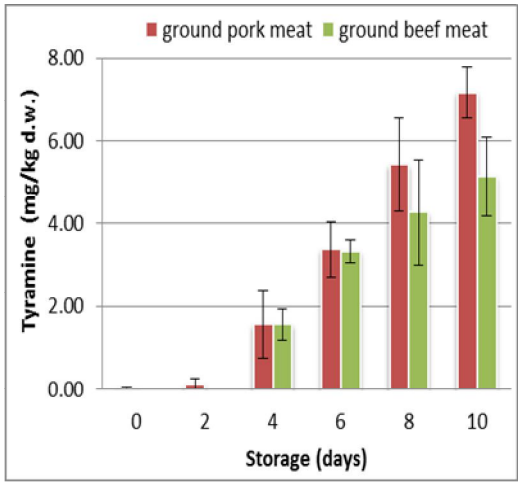

Fig. 2 Tyramine variation in ground meats

The initial amount of tyramine in both studied meats was below the detection limit of the equipment. Beginning with the second day of storage, tyramine was found only in ground pork meat, its presence being due to the microbiota that decarboxylated the corresponding amino acid. Since the fourth day of refrigeration, 1.57± 0.37 mg/kg d.w. tyramine was found in ground beef meat. In both ground meats the amount of tyramine increased, but the maximum amount did not exceed 8 mg/kg on the tenth day of storage. Our initial

findings comply with the values presented by Vidal-Carou [8].
The amount of serotonin in both types of ground meat is shown in figure 3. Initially the amount of serotonin in ground pork meat was double than that found in beef. Our findings came into contradiction with the ones found by Min [9], because serotonin in ground beef was 1.6 mg/kg and in ground pork was 0 mg/kg. This difference is probably due to the meats microbiota and the slaughtering method of animals since serotonin was found in the body, where it is produced. Serotonin is a biogenic amine that is accumulated during refrigerated storage of meats.

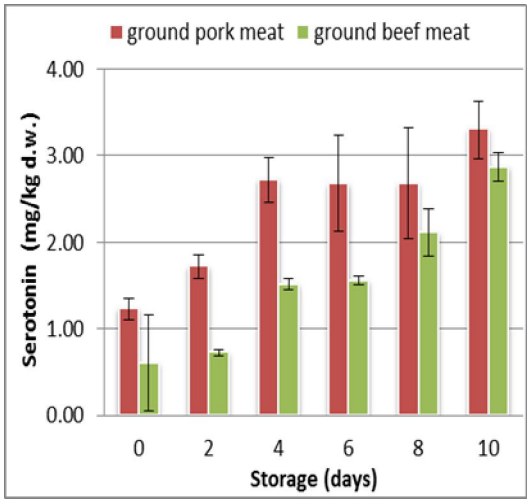

Fig. 3 Serotonin variation in ground meats

It was found in small amounts in meat because on the tenth day of storage the mean amount in ground pork meat was 3.33 mg/kg d.w., and in ground beef meat was 2.87 mg/kg d.w. According to Hernández-Jover [3], the amount of serotonin in meat and meat products in not high, being under 2 mg/kg. On the first four days of storage, respecting the validity term, the obtained results have not exceeded the limit.

The last biogenic amine studied is phenylethylamine and its variation is presented in figure 4.

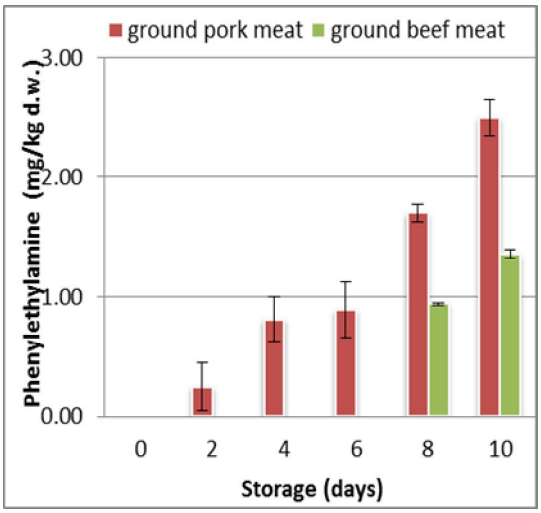

Fig. 4 Phenylethylamine variation in ground meats

Being a biogenic amine that is produced by decarboxilation from the precursor amino acid phenylalanine, initially, phenylethylamine was not found in the ground meats. This is due to the fact that the meats had a small microbial load at the beginning and low amount of free precursor amino acid. Our findings comply with those stated by Min [9], because phenylethylamine was not found in ground beef and pork meat control samples. Beginning with the second day of refrigerated storage, phenylethylamine, in a small quantity, was found only in ground pork meat. And it was found in ground beef meat beginning with the fourth day of storage, this is due to the low presence of free amino acid phenylalanine and low spoilage microbiota. On the last day of storage, the highest amount of phenylethylamine was found in ground pork meat, but it did not exceed 2.5 mg/kg d.w.

4. Conclusion

The initial quantities of biogenic amines were low or under the detection limit.
Only the serotonin content in ground beef meat was identified for the initial determination.
All the studied biogenic amine amounts have increased during the refrigerated storage.
The highest amount of biogenic amines studied on the last day of storage was registered by histamine found in ground beef meat.
After drawing a comparison between ground pork and beef meats, the highest amounts of biogenic amines was registered in beef meat on the last day of storage. This may be explained by the hygienic conditions of beef slaughter and meat storage, since the amount of biogenic amines is influenced by microbial contaminations and especially by bacterial types.
As regards shelf life, the studied biogenic amines cannot be used individually as an indicator for the biogenic amine index. Finally, the consumers' health is not jeopardized by very small amounts of biogenic amines.

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