BIOACTIVE AMINES CONTENT IN "DWARF CAVENDISH" BANANA STORED AT DIFFERENT TEMPERATURES

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„Dwarf Cavendish" banana were stored for one week at retail storage temperature. Also, banana were stored at different temperatures: refrigeration and at laboratory environmental temperature. After peeling and banana pulp processing, the samples were analyzed for bioactive amines content. There were no important variations in bioactive amines content in banana pulp from retail storage and refrigeration storage. Comparing the mean values of bioactive amines content of banana pulp from retail storage with laboratory environmental storage, at laboratory environmental temperature, putrescine content increased with 31.73%, spermine content increased with 225%, and histamine decreased with 18%. The banana pH suffered no variation after bananas storage at various temperatures.

***Key words**: bioactive amines, banana pH, storage, shelf life, refrigeration*

„Dwarf Cavendish" banana (*Musa* spp.) is the most consumed fruit in the world. It constitutes a valuable source of energy, vitamins and minerals. However, little is known about the metabolic changes of some varieties during storage and ripening. The presence of bioactive amines has been reported in different edible fruits. According to some authors, dopamine, noradrenaline, octopamine, serotonin, histamine and β-phenylethylamine have been detected in banana and banana products. Amines such as histamine, phenylethylamine and serotonin can act as protecting substances, deterring insects and molds [4]. Dopamine and noradrenaline are susceptible to enzymatic browning, being responsible for such reactions in banana [8]. According to other authors, serotonin is involve d in the regulation of a number of important functions in men, including sleeping, thirst, hunger, mood and sexual activity.

We found little information on some bioactive amines content in banana (putrescine, cadaverine, spermine, spermidine), also it were no specification if it was ripe or unripe. Also, in Romania nobody studied bioactive amines content of bananas pulp. In Romania bananas are imported from Ecuador, our country not being a producer of this type of fruit.

The objectives of this work were to study the bioactive amines content during storage of „Dwarf Cavendish" banana at different temperatures and the pH variation of banana pulp during storage.

The pH and bioactive amines changes will help to understand the shelf life of banana at the consumer's place and is interesting to know if the variation of bioactive amines content will affect the consumer's health.

MATERIAL AND METHOD

Bananas "Dwarf Cavendish" was purchased from Plus retail store situated in Bucharest, near to HORTING Bucharest. They were carried in an insulated bag for physicochemical determinations to Horting Bucharest were we determined the pH and the content for histamine, cadaverine, putrescine, spermine and spermidine. The bananas were stored for one week at 14…16°C in Plus retail storage, in the refrigerator for one week at 4°C. The banana sampling process was done according to actual laws [1]. The pH was determined as follows: banana pulp was homogenized in blander for 3 minutes, 10 g was taken and diluted 1:2 with distilled water. The pH of banana pulp was determined by inserting the electrode of a pH meter (WTW InoLab pH 730) in the diluted pulp. The biogenic amines were determined using the method recommended by the Food Research Institute from Helsinki, Finland and adapted by the team members from the Institute for Research-Development of the Horticultural Products Marketing and Industrialization, Horting, Bucharest [2,3,5,6,7,9,10].

All the reagents had analytical purity for HPLC grade. The reagents were purchased from the Merck and Sigma-Aldrich Company. We used biogenic amine standard solutions purchased from Sigma-Aldrich Company. Working solutions were prepared with a concentration of 100µg/ml and 10µg/ml. The internal standard solution, 1,7-diaminoheptan ($C_7H_{18}N_2$) was also purchased from Sigma-Aldrich Company. The concentration stock solution was prepared at 1mg/ml concentration and the working solution at 100µg/ml. Installations and equipment: homogenization type blender, Kern analytical balance, Silent CrusherM, centrifuge EBA 21, filter paper of Φ=55 mm, syringe filters having porosity of 0.45µm, agitator REAX control, ultrasonic water tank Aquawave TM, incubator BMT INCUCELL 55, water cleaning system EASY pure RoDi, filtering system with vacuum pump.

The HPLC analysis system consists in: pump, column thermostat, UV-VIS detector with diode array, computer system, and printer. Chromatography column are BDS Hypersil C18 250 x 4.6 mm, having the particles size of 5 µm and Hypersil Gold precolumns 10 x 2.1 mm. In order to make different biogenic amine concentrations (from 0.1 up to 7 µg/ml), we prepared the standard working solutions of 100 µg/ml and 10µg/ml concentrations as well as the known internal standard working solution. Then we added different volumes of perchloric acid in order to obtain a final volume of 0.5 ml. Quantitative measurements were performed depending on the internal standard, using the chromatography peaks obtained for each biogenic amine. The absorbance of derivatised biogenic amines was measured at 254 nm and the peaks were integrated with CromQuest software. Each biogenic amine concentration was expressed in µg/ml, and the biogenic amines content were expressed in mg/kg. The results obtained are of 5 determinations with 3 replicates; the mean values and standard deviation (SD) were calculated with Microsoft Excel software from Microsoft Office suite.

RESULTS AND DISCUSSIONS

Bioactive amines in banana

The bioactive amines values from "Dwarf Cavendish" bananas pulp are presented in *table 1*.

Table 1

Bioactive amines content in banana samples at different storage temperatures

Banana samples	Bioactive amines content (mg/kg dry weight)									
	Putrescine		Cadaverine		Histamine		Spermidine		Spermine	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Initially, after acquisition	12.85	0.43	2.53	0.88	2.07	0,38	3.96	0.91	2.41	0.58
Storage 1 week, at 14-16 ºC	12.72	4.50	2.11	0.63	2.13	0.52	3.84	1.20	2.46	0.60
Storage 1 week at 4ºC	11.82	0.35	2.05	0.48	2.15	0.91	3.48	0.44	2.25	0.86
Storage 1 week at 20ºC	16.76	1.01	2.33	0.62	1.81	0.47	3.56	0.97	8.01	1.00

As we mentioned before, the bananas were stored at different temperatures (as an retail storage, refrigeration, laboratory environment) for one week.

Making a comparison between bioactive amines mean quantities after bananas were purchased from Plus retail store, we can say that putrescine is the most predominant amine, followed by spermidine. Histamine has the lowest content between all the five amine studied.

The results were compared with the bioactive amines content from bananas stored at Plus retail store, at storage temperature of 14…16 °C.

In *table 1* it can be seen that comparing the mean bioactive amines content of banana pulp from Plus storage with refrigerator storage, the values of putrescine, cadaverine, histamine spermidine and spermine are approximately constant, with no important variations. This is due to the fact that the enzymes implicated in free amino acid decarboxilation from the banana pulp have the same activity in temperature interval of 4…16°C. Also, this little changes in bioactive amines content, is due to the fact that bananas were ripened.

Comparing the bioactive amines content of banana pulp from Plus storage with laboratory environmental storage, we can highlight the fact that putrescine and spermine content are increasing for the bananas stored at 20°C. Histamine content had a slight decrease in banana pulp stored at 20°C. So, the mean values of bioactive amines content of banana pulp from retail storage compared with laboratory environmental storage, in the case of banana stored at laboratory environmental temperature, putrescine content increased with 31.73 %, spermine content increased with 225 %, and histamine decreased with 18 %. Those variations are due to the decarboxilation enzymes that are more active at 20°C in bananas than at 4…16°C for putrescine and spermine formation.

pH variation in banana samples

After bananas were bought from Plus retail, the pH were 4.98.The studied banana pH had no variation when storage at room temperature. The same result was obtained with the bananas stored at refrigerator. The cause for this seems to be that the bananas stored were ripen.

CONCLUSIONS

At different temperatures of banana storage, the content of cadaverine is kept almost constant, the histamine content is slightly decreasing in case of banana storage at 20ºC, and the spermidine content is slightly varying. In case of banana kept at 20ºC for one week putrescine shows an increase in the mean value and also the spermine. We can say that in ripe bananas the temperatures influence especially the enzymatic activities. Also, the bioactive amines content variations are not causing consumer's concerning on health. The shelf life of ripe banana stored in refrigerator and in environmental air (but not to exceed 20ºC) is not suffering important transformations after a week of storage. The problem supervenes when banana are unripe and the physicochemical changes until ripening affect the sensorial and nutritional content of bananas.

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