RESPIRATION OF UNSHELLED WALNUTS (JUGLANS REGIA L)AND WALNUT KERNEL

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INTRODUCION

During postharvest handling and storage, fresh walnuts lose their quality via the respiration process. Walnut deterioration, such as lipid oxidation or impaired flavor, may result if the respiration rate is high. In order to minimize losses due to respiration, and thereby increase both market quality and shelf life, walnuts must be stored in a low temperature and low (70%) humidity environment. In this experiment the respiratory rates of nuts in English walnut (Juglans regia L.) were studied.

1. WALNUT QUALITY CHANGES DURING STORAGE

Worldwide walnuts are recommended as a constituent of balanced human nutrition. In Moldova, walnuts have been and continue to be a valuable agricultural product. Moldova is favorably positioned from a geographical point of view, on both climatic and pedological conditions for the cultivation of nuts [1], being among the top ten kernel and unshelled walnut producers in the world [2], The volume of production reaching about 30 thousand tons per year [3].

Storage of fresh harvested walnut for a certain period of time - is one of the most important processes [4]. The evolution of the chemical compounds of the walnut kernel is carried out in several ways, but the basic direction is breathing, which in fact presents a range of biochemical oxidation - reduction reactions.

It is obvious that the rate or intensity of respiration depends on the chemical composition of the walnut kernel, the degree of maturation and other external factors such as temperature, oxygen concentration in the air, etc [5-6]. Breathing is one of the oxido-reduction processes that can lead to the oxidative degradation of walnut lipids, respectively their qualitative degradation. It has been demonstrated [4] that under certain conditions the respiration intensity of walnuts is relatively slow.

For this reason, the purpose of this study was to investigate the intensity of walnuts respiration, as well as its dependence on the morphological state of stored fruits (nuts in shell or kernel) and on the temperature of the storage medium.

2. MATERIALS AND METHODS

During the research, walnuts of Calarasi variety from the harvest of 2014 were used.

To assess the intensity of respiration, as well as the influence of temperature on it, were used both nuts in shell and kernel.

To assess the influence of temperature on the respiration intensity of unshelled walnuts and kernel, they were kept under four temperature regimes: 6 ± 2^0C, 18 ± 2^0C, 30 ± 2^0C and 50 ± 2^0C. The respiration intensity of breathing was determined by the confined atmosphere process as recommended by Boysen -Jensen [7]. The CO2 capture method removed from the product with alkaline solution is the most perfect and most commonly used in scientific work.

3. RESULTS

Respiration is affected by a number of environmental factors such as light, temperature, chemical stress, pathogen attack, the action of radiation, the action of humidity, etc. The most important post-harvesting factors are temperature, atmospheric composition and physiological state.

The process of respiration of the fruit is relatively large topic discussed in the scientific literature and specialist, but the studies on Juglans Regia nuts are very limited [8-10], and on the nuts grown in Moldova are totally lacking. The evolution of breathing intensity of fresh nuts (directly after harvesting) kept at 20° C was monitored for 60 days from storage.

Initial respiration intensity of the walnuts is quite high, but falls sharply in the first 15 days of storage. In the following period, the respiration rate

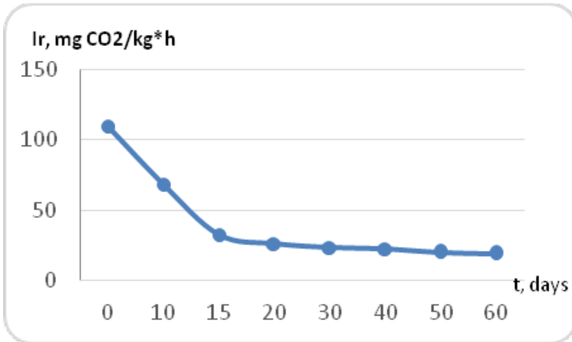

Figure 1. Evolution of respiration intensity of fresh harvested walnuts.

continues to decrease at a much lower rate. This decrease is likely (at least in part) related to the reduction in walnut moisture from 20% for fresh walnuts to 12% after 15 days and 8% - towards the end of storage.

In order to identify the impact of the ambient temperature and the walnuts morphological state on the respiration process, the respiration intensity of unshelled nuts (dried up to W = 8%) and of the walnut kernel at different temperatures was studied. The results obtained are shown in Table 1 and Figures 2 and 3.

Table 1. Respiration intensity of unshelled nuts and kernel at different temperatures, mgCO2/kg*h.

Prodct	**Temperature, ^{0}C**				
	4±2	***16±2***	***30±2***	***50±2***	***60±2***
Unshelled walnuts	4,55	6,37	17,6	15,25	13,2
Walnut kernel	5,41	7,3	22	19.8	15,32

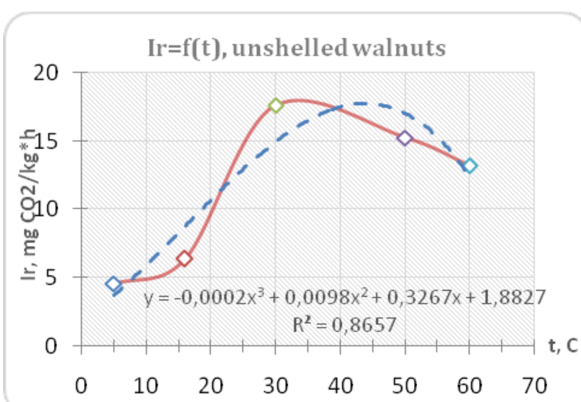

Figure 2. Dependence of the unshelled walnut respiration intensity of the ambient temperature.

The obtained data reflects the respiration intensity of walnuts in the shell. Maximum values of this indicator were obtained by storing walnuts at 30 ° C (17.6 mg CO2 / kg * h), after t> 40^{o}C the intensity of walnuts tends to decrease.

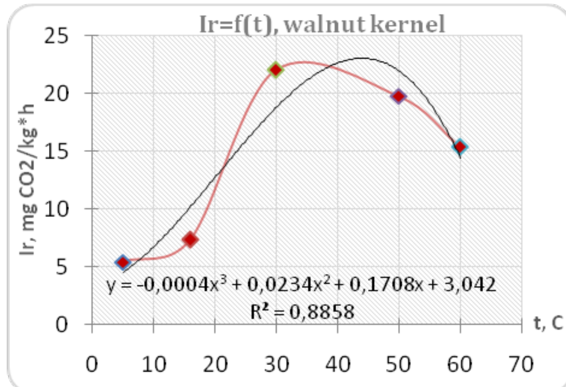

Figure 3. Dependence of the walnut kernel respiration intensity of the ambient temperature.

It has been found that the respiration intensity of the walnut kernel is greater than that of the nut in the shell. From the figures and equations presented we deduce that the respiration rate of walnuts and nuts depends largely on the temperature of their storage. Respiration intensity in both cases increases slowly with increasing temperature from 4 to 20^{0}C, then suddenly rises to the maximum value at temperatures of about 30-40^{0}C, followed by a decrease in respiration intensity at higher temperatures. It is worth mentioning that the respiration of the kernel is greater than the walnuts in shell, the shell serving as a barrier to the direct contact between the kernel and the oxygen.

Increased respiration intensity in the temperature range 20-37^o C can be explained by increasing the activity of lipases that induce lipid hydrolysis processes and increase the amount of substrate (fatty acids) for respiratory processes. Endogenous lipids in the walnut kernel hydrolyze lipids to glycerin and free fatty acids, which are then oxidized to produce the energy required for germination and plant growth. At temperatures above 40^{o}C enzymes are denatured and inactivated.

The dependence of the acidity index (expressing the free fatty acid content) of unshelled walnuts and kernel fats of nuts held at different temperatures is shown in Figure 4.

It is noted that the acidity index correlates with the storage temperature, but more pronounced in the case of the core and slower in the case of nuts in the shell.

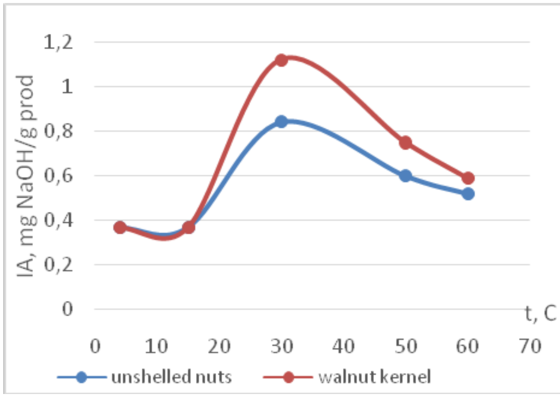

Figure 4. Dependence of acidity index of unshelled walnut and kernel lipids of storage temperature.

CONCLUSIONS

Initial respiratory intensity of walnuts is quite high, but drops sharply in the first 15 days of storage. The rate of breathing increases slowly with increasing temperature from 4 to 200°C, followed by a sudden increase to the maximum value at temperatures of about 30-400°C followed by a decrease in breathing intensity at higher temperatures. A relationship has been established between breathing intensity and storage temperature, as the temperature increases product respiration rate increases sharply (2, 3 times for each 10°C) and at 50 - 55°C reaches a maximum.

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