SOME PHYSICAL PROPERTIES OF SEABUCKTHORN AND HOW THE PACKING CONDITIONS INFLUENCE THEM

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Abstract: *I paid attention to the way how the packaging can influence the physical properties of seabuckthorn fruits (Hippoephae rhamnoides L.) during storage. The physical properties of the seabuckthorn are important in designing the equipments, in packing, as well as in higher work efficiency and identifying of the best package, in order to decrease product loss. I have analysed the physical dimensions such as length L (mm), width W (mm), thickness T (mm), geometric mean diameter Dg (mm), sphericity Φ (%), porosity ε (%), volume V (mm^3), mass m (g), bulk density ρ_b (g/cm^3), true density ρ_{tr} (g/cm^3) before and after storage in a refrigerator for 5 days at a temperature of +4^{o}C. The fruits were packed in four different packages: Samples 1 Paper and plastic (paper bag in a plastic bag); sample 2 glass jar; sample 3 paper (paper bag); sample 4 plastic box. The dimensions of the sea buckthorn fruits measured by three perpendicular directions before storage had values between : for T minimum – 5.05mm, maximum 7.6 mm, for W – minimum 5.06 mm, maximum 9.87 mm, for L – minimum 6.74 mm, maximum 9.91 mm. After the 5 days of storage at a temperature of +4^{0}C, the dimensions of the sea buckthorn fruits suffered different modifications that depended on the nature of the package used for each sample. A greater variation has been observed in T and W, compared to L.*

Keywords: *seabuckthorn, Hippoephae rhamnoides L, berries, physical properties.*

1. Introduction

The seabuckthorn (*Hippoephae rhamnoides L.*) is a shrub from *Eleagnacee* family that can find in nature but also in cultures. Seabuckthorn stands out through its exceptional capacity of adaptation in different soil and climate conditions, making it easier to grow, and to spread in the lands.

Seabuckthorn has been used for many years, not only for its therapeutical properties, but also in profilactic purpose. Seabuckthorn has won the attention of many research teams because of its nutritional, medical and cosmetic properties. Seabuckthorn is a thorny shrub, with falling leaves, widespread in Europe and Asia, being found also in Romania, where it grows spontaneous in the subcarphatic regions of Moldova and Muntenia, starting with the upper basin of the Siret to Olt.

Because of its nutritional and medical properties, it is homegrown in a large number of parts of the world [1],[2]. It is a cold and drought resistant plant, and it is considered to be a good source for a large number of bioactive substances, like: vitamins (A, C, E, K, riboflavin, folic acid), carotenoids, fitosterols (ergosterol, stigmasterol, lanosterol, amyrins), organic acids (malic and oxalic acid) polyunsaturated fatty acids, and some essential aminoacids [3, 4, 5].

This plant has been used in all nordic countries, baltic region and Asia as a human and veterinary medical drug [6],[7].

Seabuckthorn has been used in the traditional oriental system as a drug for treating skin deseases, astma, gastric ulcer and pulmonary deseases.

Recent research of the seabuckthorn have reported that it can be used also as an antioxidant, imunomodulator, anti-aterogen, anti-stress, hepatoprotector, radioprotector and tissue regenerator [8],[9],[10].

The active substances from seabuckthorn oil are anticancerous and antitumor, inhibing the development of cancerous cells, increasing the immunity, reducing the secondary effects of chemotheraphy and treating stomach, pulmonary and rectal cancer. Also it stops internal hemmoragies, destroys intestinal parasites, slows the aging process and generally acts like a tonic in stress[11],[12],[3],[13].

Given the properties of the berries in preventing illnesses but also in treating some conditions, I have determined some physical properties of the seabuckthorn fruits and the way they are influenced by the packaging and storage.

I have acorded the same atention to the bilberry, analising the behavior during the storage period, and in different packaging (plastic box with lid, jar package, double paper wrapper, plastic bag) [14].

Although many studies have considered the benefical effects of the sea buckthorn on the human organism, there is a limited number of them that describe the bioactivity of it compared to the fitochimical composition.

The objective of this study was to investigate in which way the package influences the physical proprieties of seabucktorn fruits *L (mm), W (mm), T (mm), Dg(mm), Φ(%), ε,(%), V(mm*^{3}*), m(g),* ρ_b *(kg/m*^{3}*)*, ρ_{tr} *(kg/m*^{3}*)*.

All these informations are important for designing the equipment, storage and packing to increase the work efficiency and decrease product loss.

Nomenclature

Dg-geometric mean diameter, mm
L-length, mm
m-unit mass of the seed, g
m_{100}-100 seed mass, g
S- seed surface, mm^2
T-thickness, mm
V-single seed volume, mm^3
W-width, mm
ρb-bulk density, g/cm^3
ρt –true density, g/cm^3
ε-porosity, %
Φ-sfericity, %

2. Materials and methods

2.1 Sample preparation

The analysed seabuckthorn fruits have been bought from a market in Fălticeni, Romania.

The fruits have been washed, all the impurities removed, leaves, any other foreigh bodies and dried.

I have randomly selected 10 seabuckthorn fruits, using an electronic caliper with a precision of 0.01mm, I have measured the three major perpendicular dimensions of the fruits namely length L, width W and thickness T, after which I have packed them in:

Samples:

1. *Paper and plastic (paper bag in a plastic bag)*
2. *Jar*
3. *Paper (paper bag)*
4. *Plastic box*

The samples were stored for 5 days in a refrigerator at +4^0 C and remesured.

2.2 Geometric mean diameter, sphericity, volume and surface area

The geometric mean diameter Dg and sphericity of seabuckthorn was calculated using the following relationship [15]:

$$Dg = (LWT)^{1/3} \qquad (1);$$

$$\Phi = [(LWT)^{1/3}/L] \times 100 \qquad (2);$$

for volume and seed surface was calculated by using the following relationship [16]:

$$V = \frac{\pi B^2 L^2}{6(2L-B)} \qquad (3)$$

$$S = \frac{\pi B L^2}{2L-B} \qquad (4)$$

Where B is:

$$B = (WT)^{0.5} \qquad (5)$$

2.3. One hundread fruits weight and the unit mass

To obtain the unit mass of the seabuckthorn, the mass of 100 fruits were measured with an electronic balance with an accuracy of 0.01g.

2.4. Bulk and true density

The bulk density is the ratio of mass sample of the seed of seabuckthorn to its total volume. It was determined by filling a 1000 mL container with seabuckthorn from a height of about 15 cm, triking the top level and then weighing the contents [17].

The true density was determined using water displacement method. The seabuckthorn were used to displace water in a measuring cylinder after their masses had been measured. The true density was found as an average of the ratio of their masses to the volume of water displaced by seabuckthorn [17].

2.5. Porosity

The porosity is the fraction of space in the bulk fruits that is not occupied by the fruits[18].
The porosity ε of bulk seabuckthorn was calculated using the following relationship [14]:

$$\varepsilon = \frac{\rho t - \rho b}{\rho t} X\, 100 \qquad (6)$$

Where ρ_t is true density in g/cm^3 and ρ_b is bulk density in g/cm^3

3. Results and discussion

3.1. Seed size

The dimensions of the sea buckthorn fruits measured in three perpendicular directions, before storage had the values between two intervals: L – minimum 5.05 mm, maximum 7.6 mm, W - minimum 5.06, maximum 9.87 mm, T – minimum 6.74 mm, maximum 9.91 mm

For the data analysis I have used ANOVA.

In Table 1 are the medium values and the dimension variance of the sea buckthorn L(mm), W(mm), T(mm) before storage, for every test, in Table 2 are the medium values and dimension variance of the same dimensions after 5 days of storage at a temperature of +4^{0}C.

Tabel 1
medium values and the dimension variance of the sea buckthorn L(mm), W(mm), T(mm) before storage

SAMPLE	T (mm)		L (mm)		W(mm)	
	AVERAGE	VARIANCE	AVERAGE	VARIANCE	AVERAGE	VARIANCE
1	6.09	0.41	5.97	0.21	7.96	0.66
2	6.04	0.60	5.99	0.30	7.95	0.38
3	6.10	0.13	5.87	0.23	7.59	0.08
4	6.45	0.21	6.40	0.43	7.88	0.05

From the graphical representations of the relative variations of L(%), W(%) and T(%), represented in Figure 1-3, we can compare the way how the storage influences the physical properties of the sea buckthorn fruits.

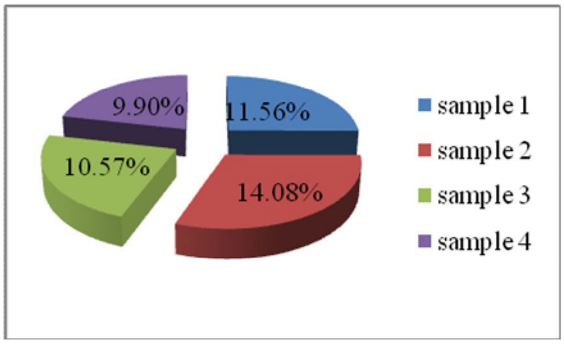


Figure 1 T(%) relative variation for every sample

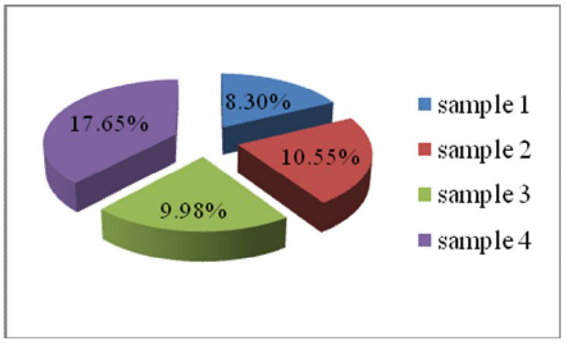


Figure 2 W(%) relative variation for every sample

Tabel 2
the medium values and dimension variance of the same dimensions after 5 days of storage at a temperature of +4^{0}C.

SAMPLE	T (mm)		L (mm)		W(mm)	
	AVERAGE	VARIANCE	AVERAGE	VARIANCE	AVERAGE	VARIANCE
1	5.90	0.25	5.70	0.39	7.84	0.63
2	5.99	0.62	6.02	0.59	8.10	0.68
3	5.84	0.45	5.91	0.32	5.91	0.35
4	5.92	0.46	6.00	0.34	6.00	0.21

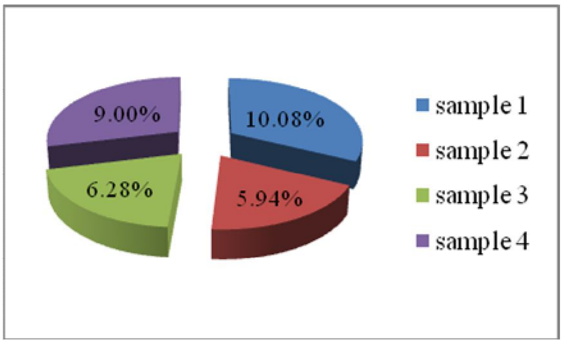


Figure 3 L(%) relative variation for every sample

3.2 Geometric mean diameter, sphericity, volume and surface area

To determinate the geometric diameter of the sea buckthorn fruits we have used Eq (1). The relative variations for each sample, after five days of storage are presented in Figure 4.

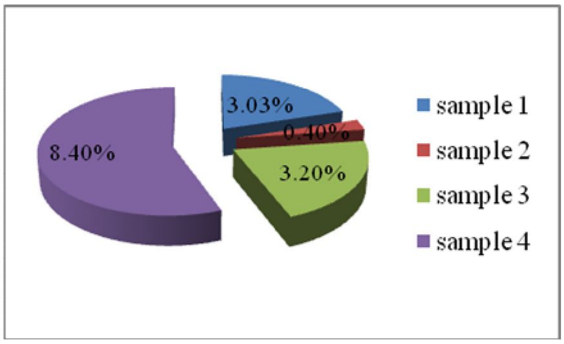


Figure 4 Dg(%) relative variation for every sample

As seen in Figure 4, the greatest variation of the geometric mean diameter is 8.8% and it is in sample 4 (plastic box) and the smallest relative variation of the geometric mean diameter has been registered for sample 2 (jar), only 0.4%.

To calculate sphericity, volume and surface sea buckthorn berries we used Eq (2), (3) and (4). The values obtained for each sample before storage are shown in Table 3, and the values obtained for each sample after the 5 days of refrigeration, are presented in Table 4.

Tabel 3

Sphericity, volume and surface sea buckthorn berries obtained for each sample before storage

Sample	S (mm^2)	V(mm^3)	Φ (%)
1	121.95	123.50	**83.33**
2	123.59	125.99	**82.34**
3	121.74	124.44	**85.67**
4	142.85	157.42	**86.35**

Tabel 4

Sphericity, volume and surface sea buckthorn berries obtained after the 5 days of refrigeration

Sample	S (mm^2)	V(mm^3)	Φ (%)
1	114.19	111.44	**82.16**
2	121.11	122.24	**82.30**
3	114.69	114.02	**85.47**
4	118.40	120.19	**87.37**

3.3. One hundread seabuckthorn weight

The average of mass of 100 seabuckthorn before storage was:

$$m_{100} = 22.75g,$$

and after storage: for sample 1was 19.1g, for sample 2 was 22.1g, for sample 3 was 20.1g, and for sample 4 was 23.0g

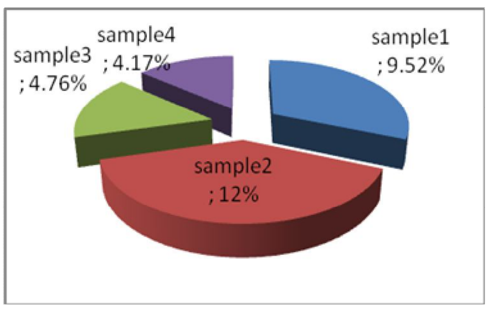
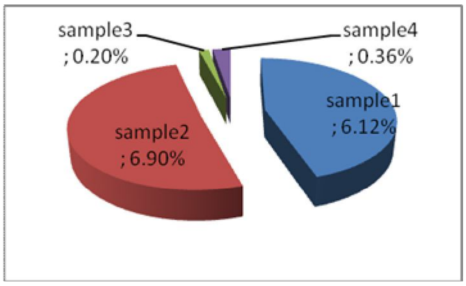


Figure 5 m_{100} relative variation for every sample

As shown in Figure 5, the largest relative variation of sea buckthorn fruits weight is 12% and this is shown in sample 2, and the lowest relative variation of sea buckthorn fruits weight was recorded for sample 4, only 4.17%.

3.4. Bulk and true density

The relative variation of bulk density, for each sample, is presented in Figure 7 and the relative variation of true density for each sample, is presented in Figure 6.



Figură 6 ρt(%) relative variation for every sample

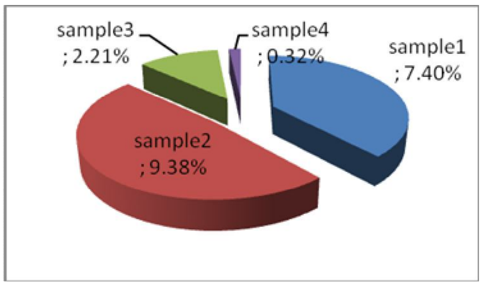


Figure 7 ρb(%) relative variation for every sample

I have observed great variations for the bulk density and for the true density for sample 2 and small variations in sample 3.

So, the highest variations are for sample 2: the relative variation of true density of the sea buckthorn fruits was 6.90%, and the relative variation for bulk density was 9.38%.

3.5. Porosity

The value of porosity were calculated with Eq (6) by using the data on bulk and true densities of seabuckthorn and the results obtained are presented in Figure 8.

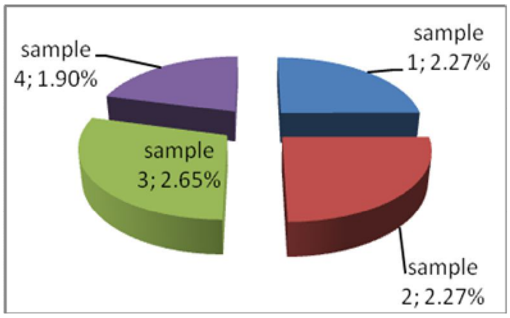


Figure 8 ε (%) relative variation for every sample

No significant variation of the porosity in none of the samples analyzed has been seen.

4. Conclusion

After the measurements made on physical properties of sea buckthorn fruits from Fălticeni area, Romania, before and after their storage for a period of 5 days at a temperature of 4 ° C in various packages, we drew the following conclusions:

1. The dimensions of the sea buckthorn fruits measured by three perpendicular directions before storage had values between : for T minimum – 5.05 mm, maximum 7.6 mm, for W – minimum 5.06 mm, maximum 9.87 mm, for L – minimum 6.74 mm, maximum 9.91 mm;
2. After the 5 days of storage at a temperature of +4^{0}C, the dimensions of the sea buckthorn fruits suffer different modifications, that depend on the nature of the package used for each sample in particular:
   - The relative variation of thickness is maximum for sample 2 (14.08%) and minimum for sample 4 (9.9%);
   - The relative variation of width is maximum for sample 4 (17.65%) and minimum for sample 1 (8.3%);
   - The relative variation of lenght is maximum for sample 1 (10.08 %) and minimum for sample 2 (5.94%);
   - The relative variation of geometric mean diameter is maximum for sample 4 (8.40%), and minimum for sample 2 (0.4%);
   - The relative variation of mass is maximum for sample 2 (12%), and minimum for sample 4 (4.17%);
   - The relative variation of bulk density is maximum for sample 2 (9.38%), and minimum for sample 4 (0.32%);
   - The relative variation of true density is maximum for sample 2, of 6.90%, and minimum for sample 4 4.17%.
3. A greater variation has been observed in T and W, compared to L.
4. No considerable variations of density have been observed in the sample 3 and sample 4.
5. The physical dimensions of the sea buckthorn fruits varied the least for the fruits in sample 4 (plastic box) and these physical dimensions varied the most for the fruits in sample 2 (jar).

5. References

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