SOME PHYSICAL PROPRETIES OF BILBERRIES AND HOW THE PACKING CONDITIONS INFLUENCE THEM

***Mihaela JARCĂU[1]**

[1]Faculty of Food Engineering, Stefan cel Mare University od Suceava, Romania
mjarcau@yahoo.com
*Corresponding author
Received 26 May 2012, accepted 8 June 2012

Abstract: *I am interested in the way the physical proprieties of the bilberry* **(***Vaccinium myrtillus) beans are influenced by the storage conditions. I have analised the dimensions (L,W,T), geometric mean diameter, sphericity, porosity, volume, and unit mass before and after storing in the refrigerator at a temperature of +4^{0}C. The beans have been packed in different packages and I noticed that the geometrical dimensions have varied so the average length, width, thickness and geometric mean diameter of seed ranged from: for SAMPLE 1 - Plastic box with lid – 8.18 to 7.73mm, 7.72 to 7.23mm, 6.13 to 5.48mm, 7.273 to 6.74mm; for SAMPLE 2 - Glass package – 7.93 to 7.20mm, 7.54 to 7.07mm, 6.06 to 5.42mm and 7.12 to 6.49mm; for SAMPLE 3 - Double paper wrapper –8.82 to 7.44mm, 8.21 to 7.04mm, 6.66 to 5.19mm and 7.84 to 6.15mm; for SAMPLE 4 -Plastic bag – 8.14 to 6.35mm, 7.82 to 6.43mm, 5.98 to 4.61mm and 7.24 to 5.72mm. After 5 days in refrigerator the average of unit mass of bilberries ranges from 0.437g to 0.433g. The objective of this study was to investigate the dependence between the packaging and the physical proprieties of bilberry, namely, size dimensions, bulk density, true density and porosity. This information is important to design equipment for aeration, storage and for omptimizing the equipment design for harvesting, handling, storing and so forth.*

Keywords: *bilberry, physical properties*

1. Introduction

The bilberry is a small size shrub that will grow up to 30-50 cm in length and can be found in the mountain areas, alpine pastures or in rocky places up to an altitude of 2500 m.

Fruits should occupy an important place in our alimentation because they contain a lot of biologically active substances that have beneficial effects on human health as antioxidants, anticancerogens, antimutagens and antibacterial compounds [1-4].

Extracts of bilberries (*Vaccinium myrtillus*) are used in gastroenteritis disease [3].

Anthocyamins and other polyphenolic compounds present in bilberries probably promote human health [5].

Bilberries have received special attention due to their history in folk medicinal uses. In 16th century, the bilberries were used for treating biliary disorders, scurvy coughs and lung tuberculosis [6].

Clinical trials have demonstrated the benefits of bilberries in the inhibition of cancer growth [7].

Lately the physical proprieties of different seeds have been studied and observed the way they vary in humidity conditions, for example the fenugreeck seed [8-10].

Having considered the beneficial proprieties of the bilberries in the treatment of different conditions but also in the

prevention of diseases I believe that it is important to analyse the way the physical propreties vary during storage depending on the type of the package.

Nomenclature

Dg-geometric mean diameter, mm
L-length, mm
m-unit mass of the seed, g
m_{100}-100 seed mass, g
R^2-determination coefficient
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, %

The objective of this study was to investigate the dependence between the packaging and the physical proprieties of bilberry, namely, size dimensions, bulk density, kernel density and porosity. This information is important to design equipment for aeration, storage and for omptimizing the equipment design for harvesting, handling, storing and so forth.

2. Materials and methods processes

2.1. Sample preparation

The bilberries used in this study were obtained from a local market in Suceava, city of Romania. The samples were cleaned manually to remove all the leaves, the green beans or other foreign bodies. (The selected beans have been packed in different materials).

I have slected 10 beans, randomly, for which I calculated L, T, W, using a caliper with a precision of 0.01mm, the beans were packed in: blastic boxes with lids, glass with paper lids, double paper wrapping, paper bag, wrapped in paper and introduced in a plastic bag (SAMPLE 1 - Plastic box with lid, SAMPLE 2 - Glass package, SAMPLE 3 - Double paper wrapper, SAMPLE 4 - Plastic bag).

2.2. Dimensions, sphericity, mass, volume and surface area.

The samples were kept at 277K (+4°C) in a refrigerator for 5 days. Ten replications of each test were made for each bag.
The geometric mean diameter Dg and sphericity Φ of bilberries was calculated by using the following relationship (Mohsenin, 1970):

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

$$\emptyset = \frac{(LWT)^{2/3}}{L} \text{ X } 100 \quad (2)$$

2.3. One hundread seed weight and the unit mass

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

The volume and seed surface was calculated using the following relationship (Jain, 1997)

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

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

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

2.4. Bulk and true density

The bulk density is the ratio of mass sample of the beans to its total volume. It was determined by filling a

1000 mL container with bilberries from a height of about 15 cm, triking the top level and then weighing the contents [9,10].

The true density was determined using water displacement method. The bilberries 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 bilberries.

2.5. Porosity

The porosity is the fraction of space in the bulk seeds that is not occupied by the seeds. The porosity ε of bulk bilberries was calculated using the following relationship:

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

Where ρ_t is true density in kg/m^3 and ρ_b is bulk density in kg/m^3

3. Results and discussion

3.1. Seed size

About 50 % of the beans have a length ranging from 8.15 to 8.86 mm, about 57.5 % a width ranging from 7.02 to 7.95, about 55 % a thinckness ranging from 6.0 to 6.97 and about 77.5 % frouits geometric mean diameter ranging from 7.01 to 7.98 (Fig. 1).

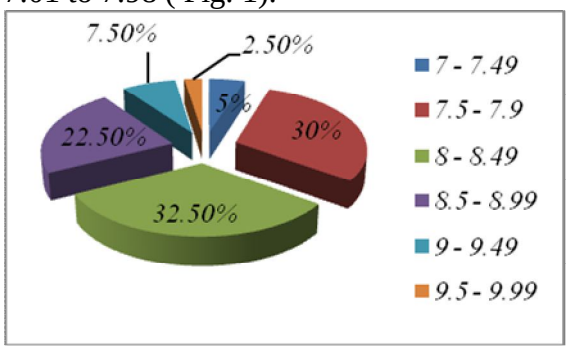

Figure 1. a Frequency distribution of bilberry seed length (mm)

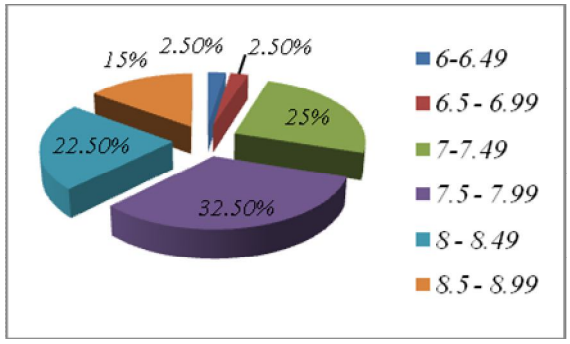

Figure 1. b Frequency distribution of bilberry seed width (mm)

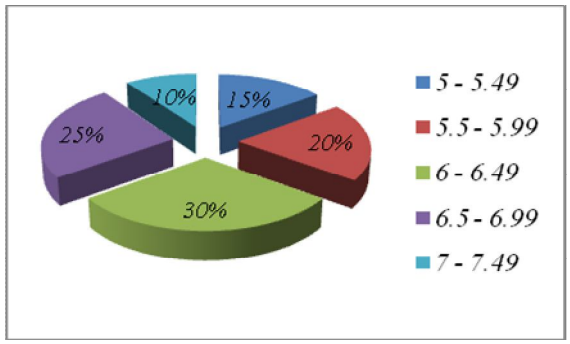

Figure1. c Frequency distribution of bilberry seed thickness (mm)

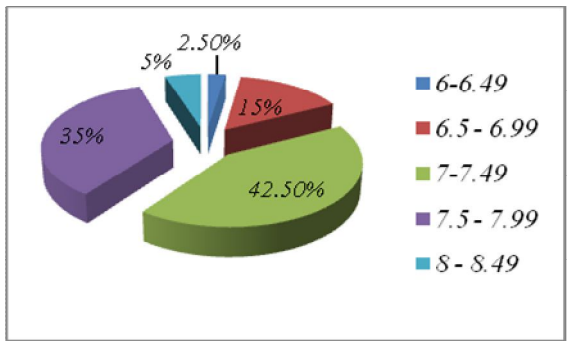

Figure 1 d. Frequency distribution of bilberry seed geometric mean diameter

The dimensions of the bilberry beans packed in different materials before and after 5 days of storage are present in Tabel 1 and 2.

Table 1
Dimensions of the packed bilberry beans

Sample	L(mm)	W(mm)	T(mm)	Dg(mm)
1	**8.18**	**7.715**	**6.125**	**7.270**
2	**7.93**	**7.535**	**6.064**	**7.120**
3	**8.82**	**8.212**	**6.663**	**7.840**
4	**8.14**	**7.817**	**5.979**	**7.247**

Table 2
Dimensions of the packed bilberry beans

Sample	L(mm)	W(mm)	T(mm)	Dg(mm)
1	7.73	7.229	5.483	6.74
2	7.20	7.071	5.422	6.50
3	7.44	7.0375	5.19	6.51
4	6.35	6.433	4.612	5.72

As shown in the table 3, the dimensions of the bilberries have decreased according to the packaging used:

Table 3
Dimensions of the packed bilberry beans after storage

Sample	$\frac{\Delta L}{L}$ (%)	$\frac{\Delta W}{W}$ (%)	$\frac{\Delta T}{T}$ (%)	$\frac{\Delta D_g}{D_g}$ (%)
1	5.5	6.3	10.5	7.3
2	9.2	6.2	10.6	8.7
3	15.6	10.6	22.1	17
4	22	8.7	22.9	21.1

In Figure 2 can be observed that the bilberry dimensions from sample 4 (Plastic bag) have the largest decrease in size, and the smallest variation in size is in sample 1 (Plastic box with lid).

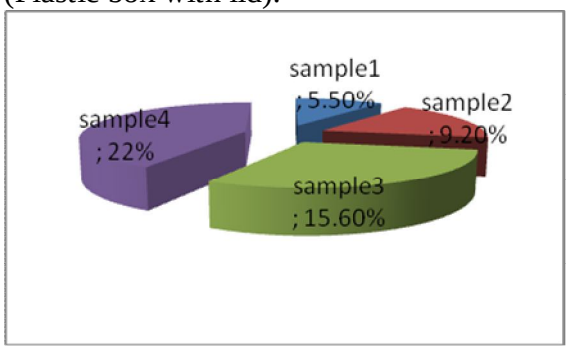

Figure 2 a L(%) relative variation for every sample

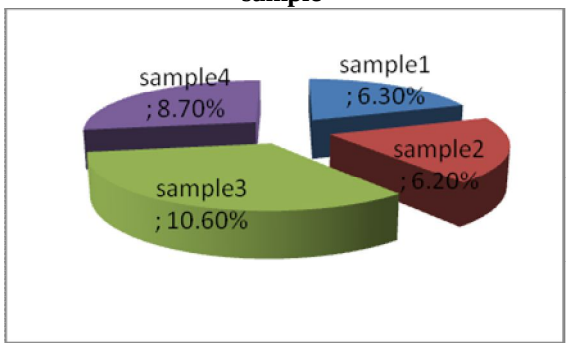

Figure 2 b. T(%) variation for every sample

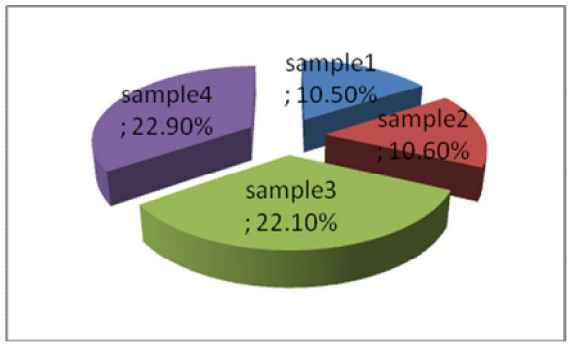

Figure 2. c T(%) variation for every sample

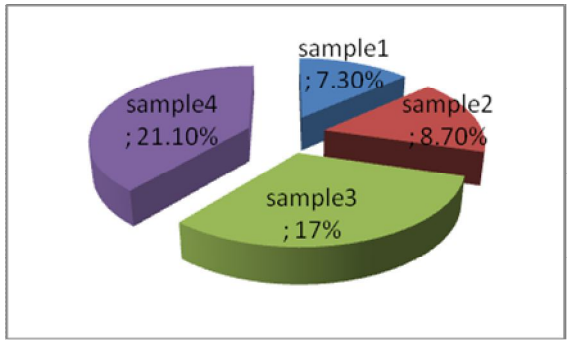

Figure 2 d D_g(%) variation for every sample

3.2. Sphericity

The values of sphericity were calculated with Eq (2) and the results obtained are presented in Fig. 3.

About 67.25 % of the fruits have sfericity ranging from 80 to 99.9 mm^3 before storage.

About 90 % of the bilberries – sample 1- have sphericity ranging from 80 to 89.9 mm^3 after 5 days; 70 % from sample 2 have sphericity ranging from 90 to 99.9 mm^3 ; 62.5% from sample 3 have sphericity ranging from 80 to 89.9 mm^3; 60% from sample 4 have sphericity ranging from 80 to 89.9 mm^3.

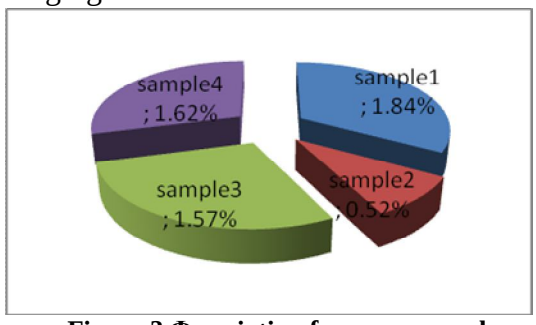

Figure 3 Φ variation for every sample

3.3. One hundread bilberries weght

The mass of 100 bilberries before storage is:

$m_{100} = 43.7 \pm R^2(g); R^2 = 0.02g;$

And after storage

$m_{100} = 43.3 \pm R^2(g); R^2 = 0.02g;$

3.4. Bulk and true density

The average of bulk density and true density of bilberries before storage is 0.57 g/cm^3 , 1.02 g/cm^3; and after storage 0.58 g/cm^3, 1.06 g/cm^3.

3.5. Porosity

The value of porosity were calculated with Eq (6) by using the data on bulk and true densities of bilberries and the results obtained are presented in fig?

The average of porosity was 0.44% before and 0.45 % after 5 days of storage.

4. Conclusion

The following conclusions are veiled from the investigation of some physical propreties of bilberries from Romania before and after storaging the in a refrigerator for 5 days at +4^{o}C in different packages.

1. The average length, width, thickness, geometric mean diameter and unit mass of the bilberries ranged from 8.27 to 7.18 mm, 7.82 to6.94 mm, 6.21 to 5.18 mm, 7.37 to 6.37 and 0.44 to0.43 g in sample 1,2,3,4.
2. Spheicity, volume of bilberries were varied from 89.21 to 89.17 mm^3, 0.43 to 0.41cm^3.
3. The true and the bulk density varied from 1.02 to 1.06 g/cm^3 and 0.57 to 0.58 g/cm^3
4. It is found that the analised physical quantities that vary most are form sample 4 (Plastic box with lid); and the least in sample 1(Plastic bag).

5. References

[1]. AWAD, M. A. (2000). Flavonoid and chlorogenic acid levels in apple fruit: characterization of variation. *Scientia Horticulturae* , 83.

[2]. HAKKINEN, S. H. (1999). Screening of selected flavonids and phenolic acid in 10 berries. *Food Research International* , 32.

[3]. BOBROWSKA E, GRZESIK, A. J.-K. (2008). Leaching of cadmium and lead from dried fruits and fruit teas to infusions and decoctions. *Joornal of Food Composition and Analysis 21* , 326

[4]. RAUHA, J. P. (2000). Antimicrobial effects of Finnish plant extracts containing flavonoids and other phenolic compunds. *Inernational Journal of Food Microbiology* , 3-12.

[5]. FRANKEL, E. N. (1999). Food antioxidants and phztochemicals: Present and future perspectives. *Fett - Lipid, 101* , 450-455.

[6]. VALENTOVA, K. U. (2007). Cytoprotective effect of a bilberry extract against oxidative damage of rat hepatocytes. *Food Chemistry* , 912-917.

[7]. ZHAO, C. G. (2004). Effects of commercial anthocyanin-rich extracts on colonic cancer and nontumorigenic colonic cell growth. *Journal of Agricultural anf Food Chemistry, 52* , 6122-6128.

[8]. EBUBEKIR, A. E. (2005). Some physical prperties of fenugreek (Trigonella foenum - graceum L.) seeds. *Journal of Food Engineering 71* , 37-43.

[9]. DESHPANDE, S. B. (1993). Physical properties of soybean seeds. *Journal of Agricultural Engineering Research, 56* , 89 - 92.

[10]. YALCIN, C. E. (2007). Physical properties of coriander seeds (Coriandrum sativum L.). *Journal of food Engineering 80* , 408 - 416.