PHYSICAL PROPERTIES OF CORIANDER SEEDS AND HOW THEY ARE INFLUENCED BY PACKAGING

Mihaela Jarcău[1*]

[1]*Ştefan cel Mare University, Suceava, Romania*

Abstract

I paid attention to how coriander seeds interact with storage container for a period of 6 months. I examined some of the physical properties of the seeds 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 for six months at normal temperature and pressure. The samples were: sample 1 coriander seeds in a plastic box with a top, sample 2 coriander seeds in a plastic bag. The physical dimensions of the samples measured in three mutually perpendicular directions before storage had values between: for T minimum – 3.39 mm, maximum 4.12 mm, for W – minimum 3.37 mm, maximum 3.80 mm, for L – minimum 4.14 mm, maximum 4.84 mm. After the six months of storage at normal temperature and pressure in various packages, the dimensions of the coriander seeds suffer different modifications that depend on the nature of the package used for each sample.

Key words: Coriander, seeds, physical properties

INTRODUCTION

Spices and herbs have always enjoyed a rich tradition of use for their aroma and also for their medicinal properties. Because globally, there is an increase in chronic diseases and hence the corresponding costs for treatment and health care, there is a growing interest for spices and herbs, both among researchers and the general public, due to their properties of prevention and treatment for some diseases [5, 7, 8, 9, 11, 12].

Archaeologists have found evidence of the use of plant leaves for flavoring meat or wine since 2300 BC [7]. Trade with spices is known to have flourished during the second century along the trade routes known as the "Silk Road". Early records show the use of herbs and spices in medicine in ancient Egypt as food preservatives in ancient Rome and Greece and for flavoring food [11].

Today, many ethnic cuisines are known after the "signature" of certain herbs or spices such as basil, garlic and oregano in Italian and Greek cuisine, and lemongrass, ginger, coriander, chilly pepper for Thaifood [8].

Coriander *(Coriandrum sativum)* is an annual herbaceous plant from the umbelliferous family, exclusively a crop plant, 30-100 cm high, emanating an unpleasant odor of bedbug, with white or pink flowers and fruit in the form of small globes, it is rich in essential oils, for which the dried seeds are used in pharmaceutical, perfumery industry and as a condiment [12].

Given the properties of coriander seeds from the culinary and medical point of view, we determined some physical properties of these seeds and how they vary during storage, depending on the container used.

I have accorded the same attention to the bilberry and sea buckthorn fruits, analyzing the behavior during the storage period, and in different packaging (plastic box with lid, jar package, double paper wrapper, plastic bag) [3, 4].

The objective of this study was to investigate in which way the package influences the physical proprieties of coriander seeds *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).*

*Corresponding author: mihaela.jarcau@fia.usv.ro
The manuscript was received: 14.03.2013
Accepted for publication: 07.10.2013

All the information is important for designing the equipment, storage and packing to increase the work efficiency and decrease product loss.

MATERIAL AND METHODS

Nomenclature

Dg-geometric mean diameter, mm
L-length, mm
m-unit mass of the seed, g
m_{100}-100 seeds 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, %

Sample preparation

The analyzed seeds have been bought from Suceava area, România.

I have randomly selected 10 seeds, 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. Coriander seeds in plastic box with a top

2. Coriander seeds in plastic bag

The samples were stored for 6 months under normal conditions of pressure and temperature and then re-measured.

Geometric mean diameter, sphericity, volume and surface area

The geometric mean diameter Dg and sphericity of seeds was calculated using the following relationship [6]:

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

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

for volume and seed surface was calculated by using the following relationship [2]:

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

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

Where B is:

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

One hundred fruits weight and the unit mass

To obtain the unit mass of the seeds, the mass of 100 seeds were measured with an electronic balance with an accuracy of 0.0001g.

Bulk and true density

The bulk density is the ratio of mass sample of the seed to its total volume. It was determined by filling a 1000 mL container with seeds from a height of about 15 cm, the excess seeds were removed using a stick and then weighing the contents [1].

The true density was determined using liquid displacement method. The seeds were used to displace Toluene (C_7H_8) in a measuring cylinder after their masses had been measured. Toluene was used instead of water because it is absorbed by seeds to a lesser extent. The true density was found as an average of the ratio of their masses to the volume of Toluene displaced by seeds [1].

Porosity

The porosity is the fraction of space in the bulk seeds that is not occupied by the seeds [10].

The porosity ε of bulk coriander seed was calculated using the following relationship [6]:

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

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

RESULTS AND DISCUSSIONS

The dimensions of the coriander seeds measured in three perpendicular directions, before storage had the values between two intervals: for T minimum – 3.39 mm, maximum 4.12 mm, for W – minimum 3.37 mm, maximum 3.80 mm, for L – minimum 4.14 mm, maximum 4.84 mm. For the data analysis I have used ANOVA single factor.

In Table 1 are the medium values and the dimension variance of the seeds L (mm), W (mm), T (mm) before storage, for every sample, in Table 2 are the medium values and dimension variance of the same dimensions after 6 months of storage under normal conditions of pressure and temperature for the all sample.

Table1 Average values and variance of coriander seeds dimensions

SAMPLE	L (mm)		W (mm)		T (mm)	
	AVERAGE	VARIANCE	AVERAGE	VARIANCE	AVERAGE	VARIANCE
1	4.57	0.06	3.56	0.02	3.75	0.06
2	4.56	0.06	3.55	0.02	3.74	0.06

Table 2 Average values and variance of coriander seeds dimensions after 6 months storage

SAMPLE	L (mm)		W (mm)		T (mm)	
	AVERAGE	VARIANCE	AVERAGE	VARIANCE	AVERAGE	VARIANCE
1	4.45	0.08	3.55	0.04	3.71	0.05
2	4.08	0.14	3.45	0.05	3.60	0.09

To highlight more clearly how these dimensions of coriander seeds varies over time for each sample, we have represented the relative variation of L in Figure 1, the relative variation of W in Figure 2 and the relative variation of T in Figure 3.

Because F (observed value) > F^{CV} (critical value) for T and W, we reject the null hypothesis.

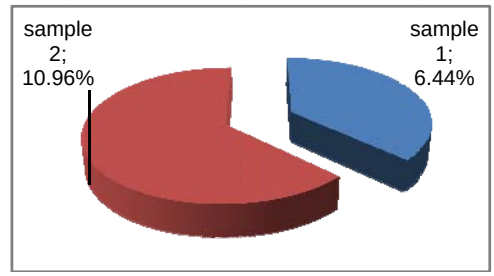

Fig. 1 The relative variation of L(%)

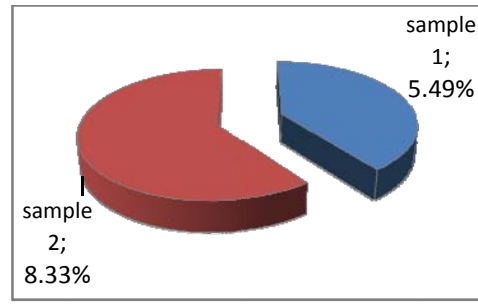

Fig. 2 The relative variation of W(%)

As we can see, the variation of the all dimensions (L, W, or T) is greatest for the sample 2.

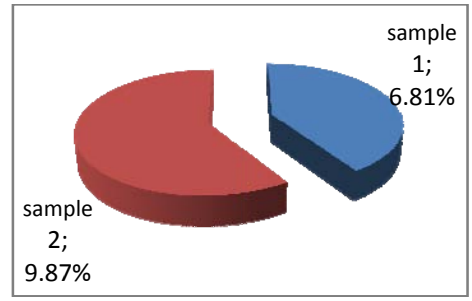

Fig. 3 The relative variation of T(%)

Geometric mean diameter, sphericity, volume and surface area

To determinate the geometric diameter of the coriander seeds we have used Eq (1). The relative variations for each sample, after 6 month of storage are presented in Figure 4.

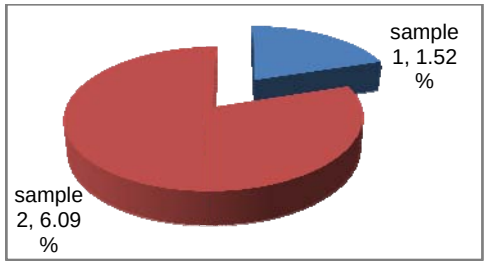

Fig. 4 The relative variation of D_g (%)

To calculate sphericity, volume and surface of coriander seeds we used Eq (2), (3) and (4). The relative variations of sphericity, volume and surface of seeds, after 6 month storage, we represented in Figure 5.

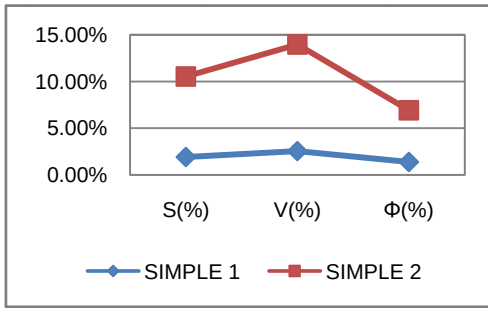

Fig. 5 The relative variation of S, V and Φ

As we can see, the variation of the sphericity, volume and surface of seeds, after 6 month storage, is greatest for sample 2.

One hundred coriander seeds weight

The mass of 100 coriander seeds before storage was: $m_{100} = 1.4482\,g$, and after storage: for sample 2 was 1.0923 g, for sample 1 was 1.2063 g.

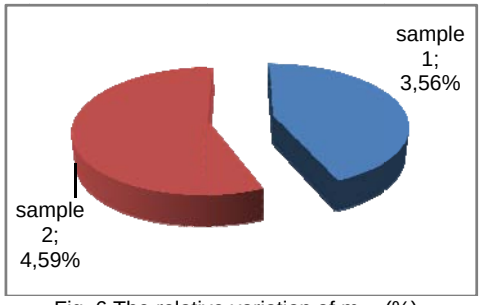

Fig. 6 The relative variation of m_{100} (%)

As shown in Figure 6, the largest relative variation of coriander seeds weight is 4.59 % and this is shown in sample 2.

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 8.

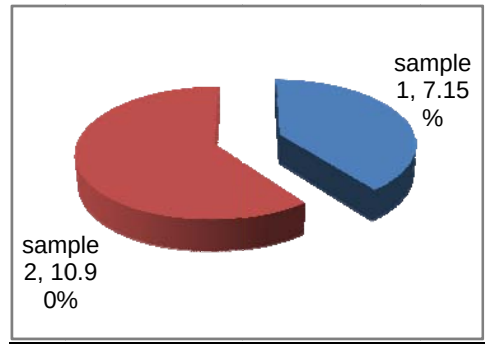

Fig. 7 The relative variation of ρb(%)

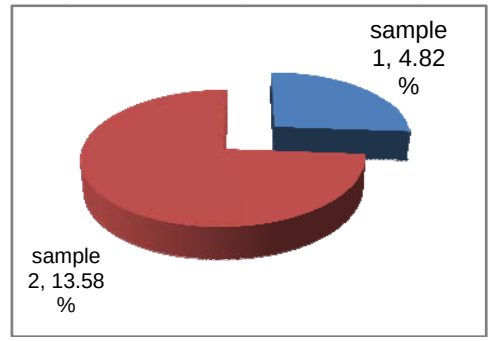

Fig. 8 The relative variation of ρt(%)

The highest variations are for sample 2: the relative variation of true density of the seeds was 10.9%, and the relative variation for bulk density was13.58%.

Porosity

The value of porosity were calculated with Eq (6) by using the data on bulk and true densities of seeds and the results obtained are presented in Figure 9.

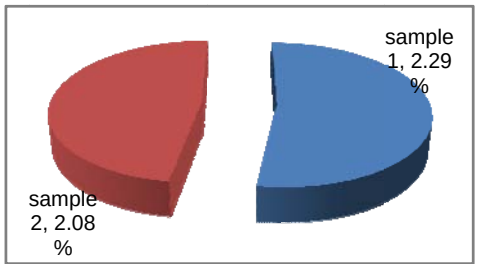

Fig. 9 The relative variation of ε (%)

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

CONCLUSIONS

After the measurements made on physical properties of coriander seeds from Suceava area, Romania, before and after their storage for a period of six months at normal temperature and pressure in various packages, we drew the following conclusions:

1. The dimensions of the seeds measured by three perpendicular directions before storage had values between: for T minimum – 3.39 mm, maximum 4.12 mm, for W – minimum 3.37 mm, maximum 3.80 mm, for L – minimum 4.14 mm, maximum 4.84 mm;

2. After the six months of storage at normal temperature and pressure in various packages, the dimensions of the coriander seeds suffer different modifications that depend on the nature of the package used for each sample.

As we can see, the variation of the all dimensions is greatest for the sample 2, except porosity of seeds which ranged roughly the same for both samples.

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