Acta Agrophysica, 2005, 5(1), 25-30

DENSITOMETRIC CLASSIFICATION OF IMBIBED PARSLEY SEEDS*

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A b s t r a c t. Densitometric classification of imbibed parsley seeds var. Olomunska was studied as a function of the imbibition's time. The seed-solution mixture was titrated with 50% saccharose solution to obtain various densities of the liquid phase. Floating seeds were counted. Density distribution was measured from 1 to 24 hours after imbibition's start. It was found that after first 8 hours density distribution remains stable.

K e y w o r d s: densitometric classification, seed classification

INTRODUCTION

Harvested plant seeds constitute a collection of particles of varied size and density. For many species certain higher density seed fractions germinate better than rest of the lot [2,3]. In the course of imbibition the volume of seeds increases and their density changes [4]. Densitometric classification gives fractionation that correlates better with seed germination [3]. It is of interest to study dependence of density distribution on the imbibition time.

The aim of this study was to find the minimal imbibiton time after which the density distribution of imbibed seeds remains stable to allow for densitometric fractionation.

METHODS

For the investigation a random samples of ca. 200 (ca. 0.3-0.5 g) seeds were taken. Seeds were then placed in a 200 cm^3 beaker and 50 cm^3 of distilled water

* The paper was presented and published in the frame of activity of the Centre of Excellence AGROPHYSICS – Contract No.: QLAM-2001-00428 sponsored by EU within the 5FP.

were added. The content of the beaker was stirred with magnetic bar in 1 hour. After that time floating seeds, if any, were removed and rejected.

Densitometric classification of imbibed seeds was carried out by removing and counting floating seeds at stepwise increased liquid phase density (in accord with Archimedes low seeds of density smaller than actual density of the liquid float). The increase in liquid density was obtained by adding portionwise (titrating) to the content of the beaker 50% solution of saccharose. All classifications were carried out at room temperature of 20°C.

Literature values of the density of water solutions of saccharose [1] are quoted as the points in Fig 1. On the basis of these data an empirical formula for the density of saccharose solutions was obtained (Fig. 1).

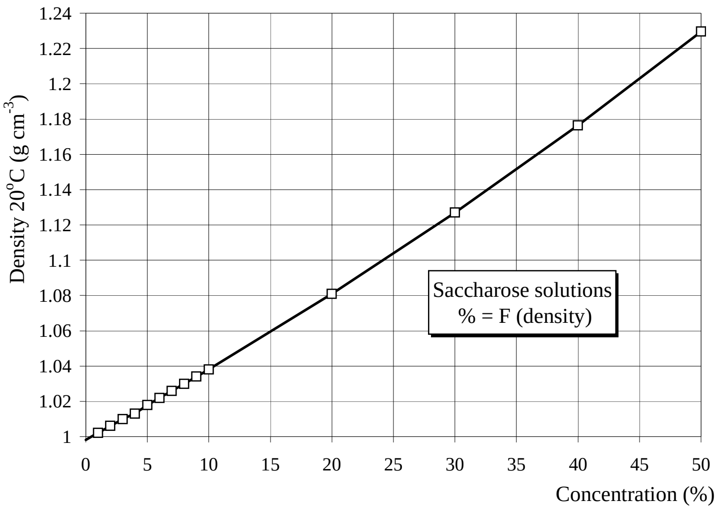

Fig. 1. Dependence of density on saccharose concentration (%) [1]

After addition of saccharose solution the final saccharose concentration in the beaker with seeds was calculated from the mass balance according to formula (1)

$$x = (V \cdot \rho \cdot X)/(m_{H_2O} + V \cdot \rho) \tag{1}$$

where:

x – final saccharose concentration (%),
m_{H_2O} – mass of water (g),
V – volume of saccharose solution added (cm^3),
X – concentration of saccharose in solution added (%),
ρ – density of added saccharose solution ($g\,cm^{-3}$).

For the density distribution measurement 70% or 50% saccharose solutions were applied. For calculation of final solution density at 20°C formula (2) was applied.

$$\rho = 3{\cdot}10^{-8} \cdot X^3 + 1{\cdot}10^{-5} \cdot X^2 + 3{,}8{\cdot}10^{-3} \cdot X + 9{,}9{\cdot}10^{-1} \quad (2)$$

To the beaker with imbibed seeds 50% or 70% saccharose solution was added from a graduated burette in 5-10 cm^3 intervals. The content was then stirred in 5 min, after the stirrer stopped the floating seeds were removed and counted. Investigation was carried out with parsley seeds var. Olomunska.

RESULTS

Seeds were imbibed for 1, 2, 4, 8, 12, and 24 hours in distilled water and subjected for densitometric analysis. As an example typical results obtained after 8 hours of imbibition are shown in Table 1.

Table 1. Densitometric analysis of parsley seeds after 2 hours imbibition (50% saccharose was used)

Volume (cm^3)	Concentration (%)	Density (g·cm^{-3})	Number of floating	Part of total number (%)	Cumulative part of total number (%)
19.0	15.9	1.0614	2.0	1.0	1.0
22.7	17.9	1.0696	1.0	0.5	1.5
26.5	19.7	1.0773	3.0	1.5	3.0
30.5	21.4	1.0845	10.0	5.1	8.1
34.7	23.0	1.0913	19.0	9.6	17.7
39.0	24.5	1.0976	42.0	21.2	38.9
43.6	25.9	1.1037	44.0	22.2	61.1
48.4	27.2	1.1094	30.0	15.2	76.3
53.5	28.4	1.1149	20.0	10.1	86.4
58.3	29.5	1.1196	15.0	7.6	93.9
70.2	31.7	1.1295	12.0	6.1	100.0

Results of the present investigation are shown in Figures 2 and 4. Imbibition of parsley seeds in excess of 4 hours increases content of fractions 1.09-1.12 g cm^3 thus narrowing distribution curve as it can be seen in Figure 2 and 4.

For the sake of comparison increase of seedbed volume as a function of imbibition time was measured with 100 cm^3 seeds placed with water in a calibrated glass cylinder. The results are shown in Table 2 and Figure 3. As it can be seen after 8 hours of imbibition 90% of volume change have already taken place.

Table 2. Increase of the volume of parsley seed placed in water

Time (h)	0	2	4	6	8	10	12	14	16	18	20	22	24
V (cm^3)	100	150	168	181	188	194	198	198	198	198	198	198	198
dV (%)	0	50	68	81	88	94	98	98	98	98	98	98	98

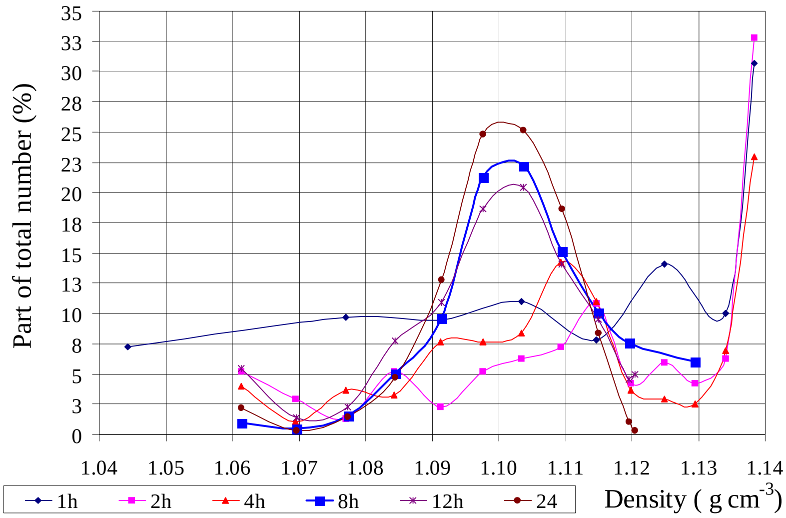

Fig. 2. Density distribution at different imbibition times

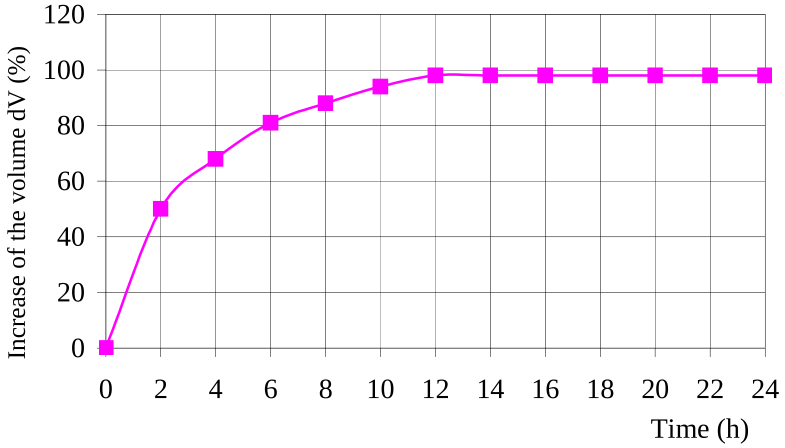

Fig. 3. Increase of the parsley seeds volume during imbibition

Above 4 hours of imbibition the moisture content of seed does not change much thus density distribution curves close on normal distribution around the average value.

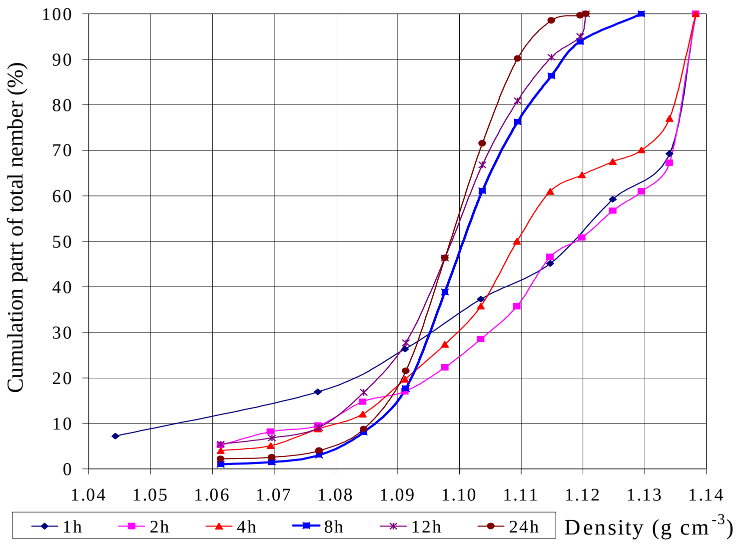

Fig. 4. Cumulative density distribution at different imbibition times

CONCLUSIONS

1. In the course of seed imbibition of distribution seed density undergo narrowing. This phenomenon should be attributed to initial differences in water absorption speed.
2. As small density seeds as well as large density seeds are always present within harvested seed lot. The presented method of gravimetric classification of imbibed seed can be useful for rejection of poorly germinating seeds.

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ROZDZIAŁ GĘSTOŚCIOWY NASION PIETRUSZKI

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Streszczenie. Wykonano rozdział gęstościowy namoczonych nasion pietruszki. Nasiona miareczkowano 50% roztworem sacharozy i zliczano nasiona pływające. Prześledzono zmiany rozkładu gęstości nasion pietruszki w czasie zamaczania w wodzie od 1 do 24 godz. Stwierdzono, że rozkład gęstościowy nasion namoczonych stabilizuje się dopiero po około 8 godzinach zamaczania nasion.

Słowa kluczowe: klasyfikacja nasion, rozdział gęstosciowy