ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering
Tome XX [2022] | Fascicule 2 [May]

[1.] Carmen BĂLŢATU, [1.] Marinela MATEESCU, [1.] Dragoş ANGHELACHE, [1.] Ana–Maria TĂBĂRAŞU

THE IMPORTANCE OF MOISTURE IN EXTRACTING OILS FROM OILSEEDS – A REVIEW

[1.]National Institute of Research – Development for Machines and Installations Designed for Agriculture and Food Industry – INMA Bucharest, ROMANIA

Abstract: Extracting oil from oilseeds is one of the most important food industries. Obtaining vegetable oils from oilseeds / oilseeds is done by various methods, of which the most used are the mechanical method (pressing) and the chemical method (solvent extraction). The oil obtained by pressing oilseeds is, in many ways, richer in vitamins, flavors, certain natural components, which make it much more suitable for human nutrition than vegetable oils obtained by other methods. Nowadays, it is experimented to obtain oil from as many seeds as possible that contribute to improving food quality. In the process of extracting oilseeds, there are several parameters that can influence the quality and quantity of oil, but in this paper, we chose to analyse the influence of humidity. Moisture is a parameter that can be measured and modified as needed. In this article, it is discussed that there is an optimal level of moisture content for each type of oilseed. The quantity of oil extracted, as well as the quality of the oil obtained are influenced by the geometric configuration of the press, by the process parameters of the equipment on the technological flow of obtaining the oil, as well as by the physical and mechanical characteristics of the oil materials. Therefore, we will analyse the existing research to see the field in which the largest amount of oil is obtained and what are the advantages and disadvantages of oil extraction at a certain value of moisture. In order to streamline the process of pressing oilseeds, an important factor is to determine the most effective point of moisture at which the oil content is the most. Of course, the moisture content acts and influences other parameters, and the recommendation is to study the raw material and do some tests before extracting the oil. The optimum moisture content is different for each type of oilseed.
Keywords: oil, moisture, extracting, oilseeds

1. INTRODUCTION

The vegetable oil industry is one of the most important sub–branches of the food industry, this industry contributing to the capitalization of Romania's agricultural potential. Vegetable oils and fats obtained in the vegetable oil industry have an important role both in food, due to their special quality and nutritional value in human nutrition, and as a raw material for various industries. In addition to the important uses of vegetable oils in various branches of industry, the importance of grinding mills and cakes resulting from the extraction of oils should also be mentioned, as these by–products are an important source of animal feed, rich in concentrated protein (30–50%), fats and vitamins, (A. Bagvand et. al,2013).

Obtaining vegetable oils from oilseeds / oilseeds is done by various methods, of which the most used are the mechanical method (pressing) and the chemical method (solvent extraction). The oil obtained by pressing oilseeds is, in many ways, richer in vitamins, flavors, certain natural components, which make it much more suitable for human nutrition than vegetable oils obtained by other methods.

The quantity of oil extracted, as well as the quality of the oil obtained are influenced by the geometric configuration of the press, by the process parameters of the equipment on the technological flow of obtaining the oil, as well as by the physical and mechanical characteristics of the oil materials. Thus, the knowledge of these factors that influence the process of obtaining oil is of real importance for specialists, designers, builders and operators in this field (E.A. Ajav, O.A., 2013).

Although the field of oilseeds is very wide, there are not many plants that can be used as raw material in the vegetable oil industry, as many of them have a low oil content – being unprofitable, and others with higher content have difficulties in obtaining it, due to the special structure of the plant.

Table 1. The composition and characteristics of the main oil plants (I. Banu, 2008)

Raw material	Hectolitre mass, kg / hl	The contents of the shell	Chemical composition, %					
			Moisture	Protein	Oil	Nonzonate extractive substance	Cellulose	Ash
Sunflower	38–42	14–28	14–28	44–48	18–20	10–15	14–18	2–3
Soy	70–75	7–12	11–13	17–19	33–36	20–23	4–5	3–5
Flaxseed oil	65–69	4–6	9–11	35–38	25–27	20–23	4–5	3–4
Rape	65–70	4–6	6–8	35–42	25–28	17–20	4–6	3–5
Ricin	48–50	22–25	6–9	44–52	14–18	15–17	15–18	2–4
Hemp	48–58	20–25	5–12	28–34	15–27	15–25	12–16	3–5

Mass hectolitre (MH) or volumetric mass is the mass of one hectolitre of seed (equivalent to 0,1 m^3) expressed in kilograms (kg / hl). This property is significantly influenced by seed moisture, seed surface condition, specific mass, degree of compression of seed substances, presence of foreign bodies, (M. Panainte, 2005).

2. MATERIALS AND METHODS

Humidity (U) is the amount of water contained in the seed sample relative to the mass of the sample analysed, expressed as a percentage.

Seed moisture can be determined by direct or indirect methods, the most accurate direct method being oven drying, which involves introducing the seed sample into the oven at 104 ° C for 24 hours and determining by, (A. Bagvand, 2013):

$$u = \frac{M - Mo}{Mo} 100\ \%$$

where: M is the mass of the seed sample before drying, (g); M_o – the mass of the seed sample after drying, (g).

Seed moisture at harvest is usually high and unsuitable for optimal storage. The species, variety or degree of maturity of the seeds are factors that influence the value of moisture, which varies within very wide limits. Humidity also varies inside the seed, so it is higher inside (in the embryo) than outside the seed, (I. Banu, 2008).

The most important factor that influences the storage in optimal conditions is the humidity of the seeds. In order to avoid the negative effects of storage (self–heating, mould, heating) which reduces the technological and food value, it is necessary that the seeds be brought to a humidity below the critical humidity. The critical humidity has the following values for different oilseeds: sunflower 8.5%, hazelnuts 9.0%, flax seeds 10.5% and soybeans 13.0%, (B.D. Shukla, 1992).

3. RESULTS

For the most efficient extraction of the oil, it is considered that there is an optimal level of moisture content for each type of seed. For example, in the case of rapeseed, the optimum moisture content is around 7%, (P.C. Bargale et.al., 2000) for sunflower seeds, the optimum humidity is between 6–7% and for flax and flax seeds. Soybean, the optimum moisture content is about 6%, (S. Karaj, 2014).

Y.L. Zheng et al., studied the influence of moisture content on the pressing process, using a Komet S 87G screw press and two varieties of flaxseed, Omega and Neche. The experiments were carried out in four stages: pressing of whole Omega seeds, with the moisture content varying in the range of 6.1–11.6% (relative to dry mass) and two dimensions of the outlet, 6 mm and 8 mm, respectively; pressing whole Neche seeds, with humidity ranging between 6.1–13.4% (dry mass) and 6 mm outlet; pressing of peeled Omega seeds, with a moisture content between 7.7–11.2% (dry mass) and the size of the outlet of 6 mm. When pressing the Omega flax seeds using the 6 mm grout outlet, an inverse relationship was observed between the moisture content of the seeds (between 6.1 and 11.6%) and the yield of extracted oil (between 70.1 and 85,7%). The dependence between productivity and moisture content was less obvious when the outlet was 6 mm than when it was 8 mm in size. An inverse relationship was also observed between the moisture content of whole flaxseed and the temperature of the oil and grit.

Figure 1, shows the dependencies between the moisture content and the yield of extracted oil (figure 1 A) and between the moisture content and productivity (figure 1 B), for the two varieties of flax seeds, for different dimensions of the orifice evacuation.

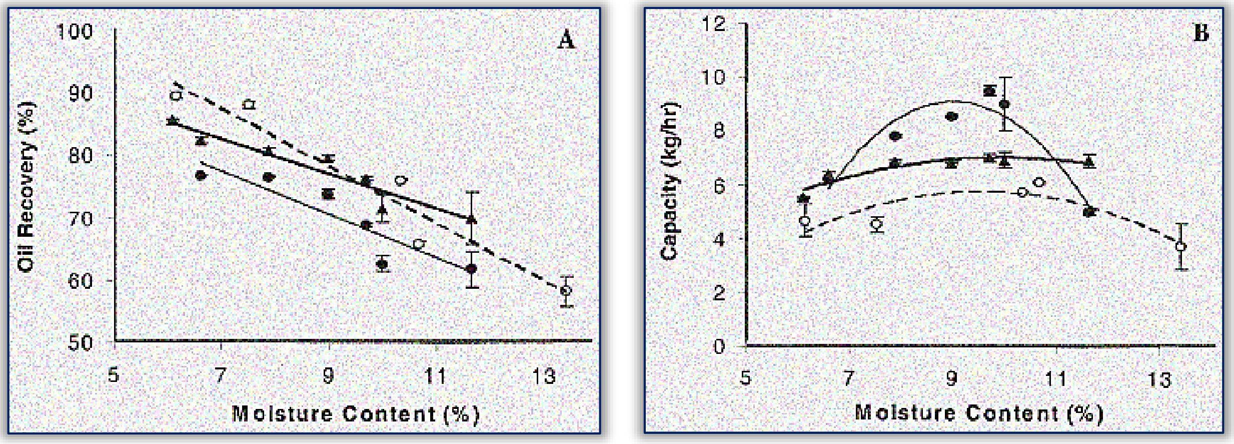

Figure 1. Oil recovery (A) and capacity (B) of pressing whole flaxseed as influenced by moisture content, choke size, and variety. (●) Omega, choke size 8 mm; (▲) Omega, choke size 6 mm; (●) Neche, choke size 6 mm. Error bars represent the SD (Y.L. Zheng et al.,2003

Another study that looked at the influence of the initial and final moisture content of roasted and ground cuphea (cigarette plant) seeds was performed using a snail laboratory press, manufactured by the French Oil Mill Machinery Company, (L.E. Roque et.al, 2007).

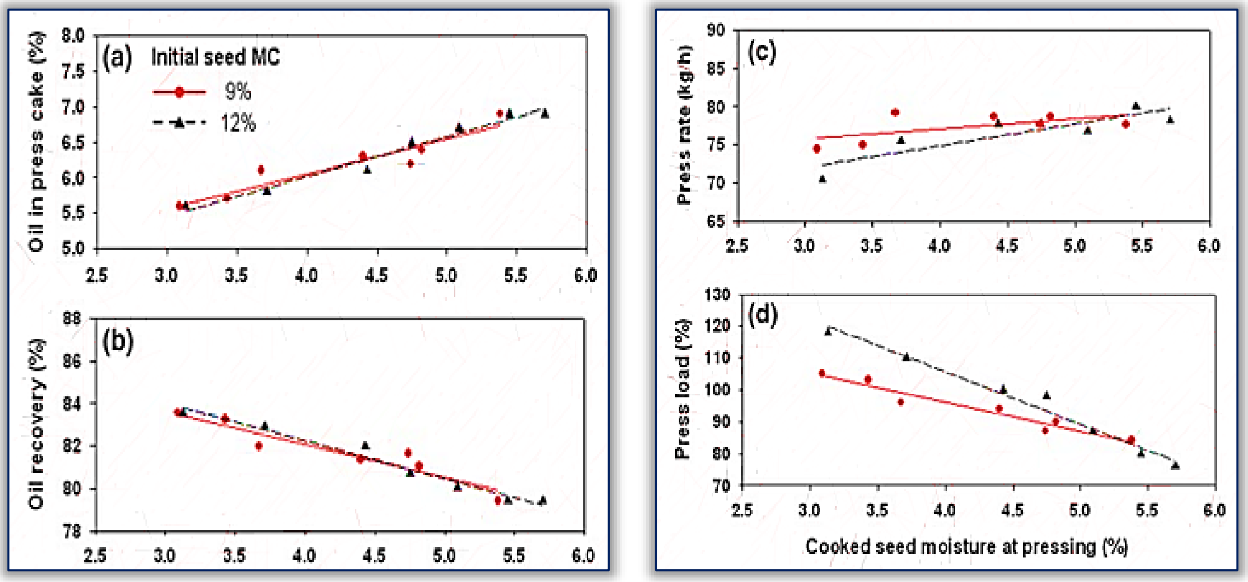

Figure 2. The influence of the moisture content of roasted and crushed cup seeds on:
a) residual oil from grinding; b) oil yield; c) processing capacity, (L.E. Roque et.al, 2007)

Seeds with an initial moisture content of 9% and 12% were crushed and fried for different periods of time until moisture content values of 3.0–5.5% were obtained. From Fig. 2, a, it is observed that the residual oil from the grit decreases significantly with the decrease of the moisture content of the fried and crushed seeds. The minimum amount of 5.6% residual oil was obtained for a moisture content of 3.1% of the fried seeds. In Figure 2, b, it is observed that when the moisture content of roasted seeds decreased from 5.5% to 3.1%, the yield of extracted oil increased from 79.4% to 83.6%. However, the moisture content of the seeds does not affect the processing capacity in the case of seeds with a moisture content of 9% (fig.2, c). Processing capacity decreased by 3.8% (from 79 kg / h to 76 kg / h) when the moisture content of roasted and crushed seeds decreased from 5.7% to 3.1%.

4. CONCLUSIONS

In order to streamline the process of pressing oilseeds, an important factor is to determine the most effective point of moisture at which the oil content is the most. Of course, the moisture content acts and influences other parameters, and the recommendation is to study the raw material and do some tests before extracting the oil. The optimum moisture content is different for each type of oilseed.

Acknowledgement

This paper was financed with the support of National Agency for Scientific Research and Innovation, NUCLEU Programme, no. 5N / 07.02.2019, project PN 19/10/01/03 – "Fundamentarea tehnologiei de recoltare şi prelucrare primară a tulpinilor de cânepă în verd"

Note:

This paper was presented at ISB–INMA TEH' 2021 – International Symposium, organized by University "POLITEHNICA" of Bucuresti, Faculty of Biotechnical Systems Engineering, National Institute for Research–Development of Machines and Installations designed for Agriculture and Food Industry (INMA Bucuresti), National Research & Development Institute for Food Bioresources (IBA Bucuresti), University of Agronomic Sciences and Veterinary Medicine of Bucuresti (UASVMB), Research–Development Institute for Plant Protection – (ICDPP Bucuresti), Research and Development Institute for Processing and Marketing of the Horticultural Products (HORTING), Hydraulics and Pneumatics Research Institute (INOE 2000 IHP) and Romanian Agricultural Mechanical Engineers Society (SIMAR), in Bucuresti, ROMANIA, in 29 October, 2021.

References

[1] Bagvand, A.N. Lorestani, (2013) „Determination of Physical Properties and Mechanical Behavior of Sunflower seeds", International Jorunal of Agriculture and Crop Sciences, Vol. 5(11), 1255–1259
[2] B.D. Shukla, P.K. Srivastava, R.K. Gupta, „Oilseeds Processing Technology", Central Institute of Agricultural Engineering, India, 1992
[3] E.A. Ajav, O.A. (2013) Fakayode, „Mechanical Properties of Moringa (Moringa oleifera) Seeds in relation to an Oil Expeller Design", Agrosearch 13 No.3: 206 – 216.
[4] I. Banu,(2008) „Principii generale de morărit. Tehnologii generale în industria alimentară –Tehnologia morăritului".
[5] K.K. Singh, D.P. Wiesenborn, K. Tostenson, N. Kangas, (2002) *„Influence of moisture contentand cooking on screw pressing of crambe seed"*, Journal of the Amercian Oil Chemists' Society, vol. 79, nr.2.
[6] L.E. Roque, S.C. Cermak, (2007) „Full–Press Oil Extraction of Cuphea (PSR23) Seeds", Journal of the American Oil Chemists Society 84:1169–1175, https://doi.org/10.1007/s11746–007–1142–5.

[7] M. Panainte, E. Moşneguţu, C. Savin, V. Nedeff,(2005) „Mărunţirea produselor agroalimentare", Editura Meronia, Rovimed Publishers, ISBN 973–8200–88–1, 973–7719–39–5, Bacău.
[8] P.C. Bargale, J. Singh, (2000) „Oil expression characteristics of rapeseed for a small capacity screw press", Journal of Food Science Technology, vol. 37, pg. 130–134.
[9] S. Karaj, J. Müller (2014), Characterization of physico–chemical properties of Jatropha curcas L. and optimization of mechanical oil extraction and sedimentation, INSTITUTE OF AGRICULTURAL ENGINEERING Universität Hohenheim DOI:10.2370/9783844025163
[10] Y.L. Zheng, D.P. Wiesenborn, K. Tostenson, N. Kangas, (2005) „Energy analysis in the screw pressing of whole and dehulled flaxseed", Journal of Food Engineering, vol. 66, pg.193–202.
[11] Y.L. Zheng, D.P. Wiesenborn, K. Tostenson, N. Kangas, (2003) „Screw pressing of Whole and Dehulled Flaxseed for Organic Oil", Journal of the American Oil Chemists' Society, vol. 80, pg. 1039–1045.

ISSN 1584 – 2665 (printed version); ISSN 2601 – 2332 (online); ISSN–L 1584 – 2665