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Researches Regarding the Processing of the Hemp Seed by Cold Pressing

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Abstract The hemp (*Cannabis sativa L.*) seeds present an important raw material resource for the industry due to processing possibilities of plants components. The hemp oil and the pressing cake resulted by the cold pressing of the hemp presents excellent alimentary and therapeutic properties.

The purpose of the research was to study the technology of obtaining of the hemp oil by cold pressing of the seeds, the influence of the process parameters and raw materials quality upon the products quality.

The pressing was made with screw press of small using press nozzle in diameters of 5, 6, 7, 8 and 10 mm. For the hemp seed there were determined the organoleptic characteristics (total volatile matter and the raw fat content by Soxhlet extraction). For the hemp oil there were determined the acid value and the peroxide value. There werde determined the working parameters of the press (the rate efficiency and the productivity of the press).

The results emphasized important data for the practice. The fat content of the seed was between 30,89 and 33,25 % and the volatile matter was between 90,42 and 93,68 %. The rate efficieny of the cold pressing of the hemp seed was between 23,89 and 27,69 % obtained oil, being influenced by the characteristics of the seeds. The pressing process was also influenced by the quality of the seed, presenting optimal values in the case of using pressing nozzle 8 and 10 mm in diameter. The acid values of the hemp oil was between 0,65 and 4,45 mg KOH/g oil and the peroxide values was between 0,62 and 26,91 mEg O2/g. Further studies are recommended be made and there are the initiations of ab informational programme, in order to inform the farmers and consumer about the benefic and therapeutic effects of the hemp oil upon the health.

Key words: hemp seed, cold pressing, hemp oil.

INTRODUCTION

The hemp (*Cannabis sativa L.*) seeds present an important raw material resource for the industry due to its value provided by the several processing possibilities and products obtained from all the components of the plants. From the hemp grown for non-drug purposes there are obtained several products as food, fuels, textiles, paper or even biodegradable plastics.

The processing of the hemp seed by cold pressing results in oil and pressing cakes, with alimentary use, having also excellent therapeutic properties. Their use were attested to be known since ancient time by Chinese, 12000 years ago, or by the traces founded in the tombs of the ancient Egyptians.

The composition and the principal characteristics of the hemp seed compared to those of the most important oleaginous seeds are presented in Tab. 1. There is to be observed that in the hemp seed the fat content is considerable.

Tab. 1

Composition and characteristics of the hemp seed compared to other oleagionous seeds (Banu, 2009)

Specification oil seed	Hectolitric weight kg·hL^{-1}	Hulls content	Chemical composition (%)					
			Moisture	Fat	Proteine	NfE[1]	Celulosis	Ash
Hemp	48-58	20-25	5-12	28-34	15-27	15-25	12-16	3-5
Sun flower	38-42	14-28	9-11	44-48	18-20	10-15	14-18	2-3
Soya	70-75	7-12	11-13	17-19	33-36	20-23	4-5	3-5
Linen	65-69	4-6	9-11	35-38	25-27	20-23	4-5	3-4
Rape (Canola)	65-70	4-6	6-8	35-42	25-28	17-20	4-6	3-5

[1]Nf.E. – Azot free extract

The hemp seeds contain all the essential amino acids and considerable essential fatty acids in the composition of its fat content. These are also a source of calcium, iron, phosphorus, magnesium, zinc, copper and manganese. The psychoactive Cannabinoide Δ-9-THC is not synthesized in the seeds and therefore there exists special requirements concerning the purity of the industrial hemp seed (proper removing of impurities as other parts of the plant) in order to avoid eventual THC traces in the processed products. The composition of the hemp oil is presented in the table 2, together with the composition of other vegetable oil.

Tab. 2

Fatty acid composition of oils (%) (Sanders, on: http://www.goodwebsite.co.uk/kingsreport.pdf).

SFA- Saturated Fatty Acids, MUFA-Mono-Unsaturated Fatty Acids, PUFA-Poli-Unsaturated Fatty Acids

Fatty acids / Edible oil	%	SFA	MUFA	PUFA	Linoleic 18:2 ω-6	GLA 18:3 ω-6	ALA 18:3 ω-3	Steara-donic 18:4 ω-3	ω-6	ω-3	ω-6/ ω-3
Hemp seed oil	99,9	7,31	10,57	75,96	53,82	3,31	17,19	1,63	57,13	18,82	3,1
Walnut oil	99,9	9,10	16,40	69,90	58,40	0,00	11,50	0,00	58,40	11,50	5,1
Rapeseed oil	99,9	6,60	59,20	29,30	19,70	0,00	9,60	0,00	19,70	9,60	2,1
Soya oil	99,9	15,60	21,20	58,80	51,50	0,00	7,30	0,00	51,50	7,30	7,1
Sunflower oil	99,9	12,00	20,50	63,30	63,20	0,00	0,10	0,00	63,20	0,10	632,0
Linseed/ flaxseed	99,9	9,4	20,2	66,00	12,7	0,00	53,3	0,00	12,7	53,3	0,2

The data emphasizes the ideal rate of the essential fatty oil ω-6 to ω-3 of 3 to 1, which are considered by the specialist to be the most optimal rate for the intake of these essential fatty acids by the human body. The considerable content of γ-linolenic acid (GLA) and the stearadonic acid content provide to the oil a distinct value. The hemp oil contains antioxidants and possesses a remarkable radical scavenging activity and oxygen radical absorption capacity, as recorded in the literature (Ramadan, 2006, Boskou, 2006). The alimentary and therapeutic properties are also provided by active principles with very important biological

function, as the for example the phenolic compounds (0.44 mg GE/g, gallic acid equivalent (GE) per gramme) of the cold-pressed hemp seed oil (L.L.Yu,2005), tocopherols and terpenes.

MATHERIALS AND METHODS

The purpose of the research was to study the technology of cold pressing of the hemp seed and the influence of its quality upon the obtained products.

There were tested 3 types of hemp seeds, of different provenience, and certified by an authorized laboratory for being free of Δ-9-THC (with a concentration below 1 ppm). The hemp seeds were conditioned (i.e. selected, purified and dried) for a proper storage.

There were analysed for the hemp seeds: the organoleptic characteristics, the moisture contents (total volatile matter) and the raw fat content (by Soxhlet extraction).

The pressing of the seeds was made with a screw press of small capacity (up to 5 kg oleaginous seed per hour and fixed rotations speed: 60 rpm) in the vegetal oil technology laboratory of the USAMV, Cluj-Napoca. The technological characteristics of the press was varied by using different press nozzles, in diameters of 4, 5, 6, 7, 8 (hemp seeds I, II and III) and also of 10 mm (hemp seed I and II).

In order to study cold pressing technology of the hemp seed there were evaluated the working parameters of the press (the rated efficiency of the extracted oil $\eta_{O/S}$) and the productivity of the press. The productivity of the press was related to hemp seed processed per hour - $P_{Hemp\ seed}$ (kg/h) and to hemp oil obtained per hour - $P_{Hemp\ oil}$ (kg/h). Therefore there were recorded for each variant of pressing process the data of the input (hemp seed) and output (oil and pressing cake), as well as the pressing time (s).

For the raw cold pressed hemp oil there were determined the acid value and the peroxide value.

RESULTS AND DISSCUSIONS

The organoleptic analysis of the hemp seed did not revealed modified smell and taste.

The data of the determination of the dry matter and fat content are presented in the table 3. The analysed hemp seed had a fat content with values between 30,89 and 33,25%. The total volatile matter of the tested hemp seed was of 6,32 % (hemp seed I), of 8,18 % (hemp seed II) and 9,58 % (hemp seed III).

Tab. 3

The dry matter content and fat content of the studied hemp seed

Crt. No.	Specification of the sample	Dry matter (%)	Fat content (%)
1.	Hemp seed I	93,68	33,25
2.	Hemp seed II	91,82	31,34
3.	Hemp seed III	90,42	30,89

The obtained cold pressed hemp oil emphasized a pleasant nutty, also with a lightly grassier flavor. The color of cold pressed raw oil was dark green to a bit lighter green, depending on the different pressing conditions, i.e. the diameter of the press nozzle, and therefore different temperatures developed in the screw press.

The pressing rate efficiency related to the hemp seed (kg hemp oil processed from 100 kg seed $\eta_{O/S}$ (%) and the press productivity $P_{Hemp\ seed}$ (related to the quantity of hemp seed

processed per hour: kg hemp Seed/h) and $P_{HempOil}$ (related to the quantity of hemp oil processed per hour: kg hemp oil/h) are presented in the Tab. 4.

Tab. 4

The working the parameters of the screw press at the processing of the hemp seed by cold pressing: the rate efficiency ($\eta_{O/S}$ obtained oil from processed seed , %) and press productivity ($P_{Hemp\ seed}$ - kg hemp seed/h and $P_{Hemp\ oil}$ - kg hemp seed oil/h)

Crt. Nr.	Specification pressing variant	ϕ (mm)	Pressing rate efficiency	Press productivity	
			$\eta_{O/S}$ (%)	$P_{Hemp\ seed}$ (kg/h)	$P_{Hemp\ oil}$ (kg/h)
	Hemp seed I	4	30,00	0,41	0,12
	Hemp seed I	5	27,48	3,11	0,85
	Hemp seed I	6	27,92	2,23	0,62
	Hemp seed I	7	27,69	3,62	1,00
	Hemp seed I	8	26,64	4,50	1,20
	Hemp seed I	10	27,10	3,90	1,06
	Hemp seed II	5	27,60	3,31	0,91
	Hemp seed II	6	26,80	2,72	0,73
	Hemp seed II	7	25,60	3,47	0,89
	Hemp seed II	8	25,60	3,67	0,94
	Hemp seed II	10	24,80	4,92	1,22
	Hemp seed III	5	26,67	4,00	1,07
	Hemp seed III	6	27,22	3,90	1,06
	Hemp seed III	7	23,89	4,32	1,03
	Hemp seed III	8	23,89	4,24	1,01

The pressing rate efficiency varies between 23,89 and 27,69 kg processed oil from 100 kg hemp seeds and depended on the diameter of the press nozzle as well as on the hemp seed characteristics. The oil quantity processed from 100 kg hemp seed is higher in the case of using a press nozzle smaller in diameter. It depends also on the humidity content of the hemps seed and showed different optimal values by pressing with nozzle in diameter of 5 mm (hemp seed II) and 6 mm for the hemp seed I and III. The using of the press nozzle of 4 mm was possible only in the case of the hemp seed I, with lower total volatile contents of 6,32 %.

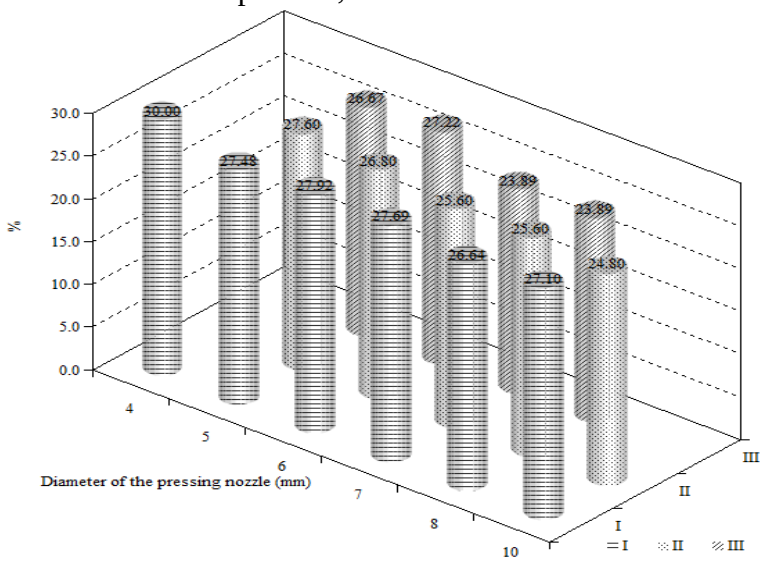

Fig. 1. Pressing rate of the process (oil obtained by pressing of 100 kg hemp seed); I, II, III – the three hemp seeds sorts used for the processing of oil.

As to be seen in the Fig. 1, the rate efficiency was higher for the hemp seed with lower total volatile matter (sort I- 6,32 %) and lower for the sorts II and III (8,18 % and 9,58 %) with higher values in total volatile matter.

The highest quantity of oil obtained per hour by pressing of the hemp seed was also related to the characteristics of the press and input characteristics. The best values for the hemp oil obtained per hour were for hemp seed sorts with lower total volatile matter and by using press nozzles with diameters of 8 mm (1,20 kg hemp oil/h for the seeds I) and 10 mm (1,22 kg hemp oil/h for the seeds II).

Compared to the processing of other oleaginous seeds by cold pressing, the productivity of the press for hemp seeds processing is lower as for sunflower seed (Morar, 2004) or rape seed processing (Morar, 2004).

From the Fig. 2 there can be observed that the values for the press productivity varies more for the hemp seed with lower value of the total volatile matter (I) than for the sorts with higher total volatile content (hemp seeds II and II).

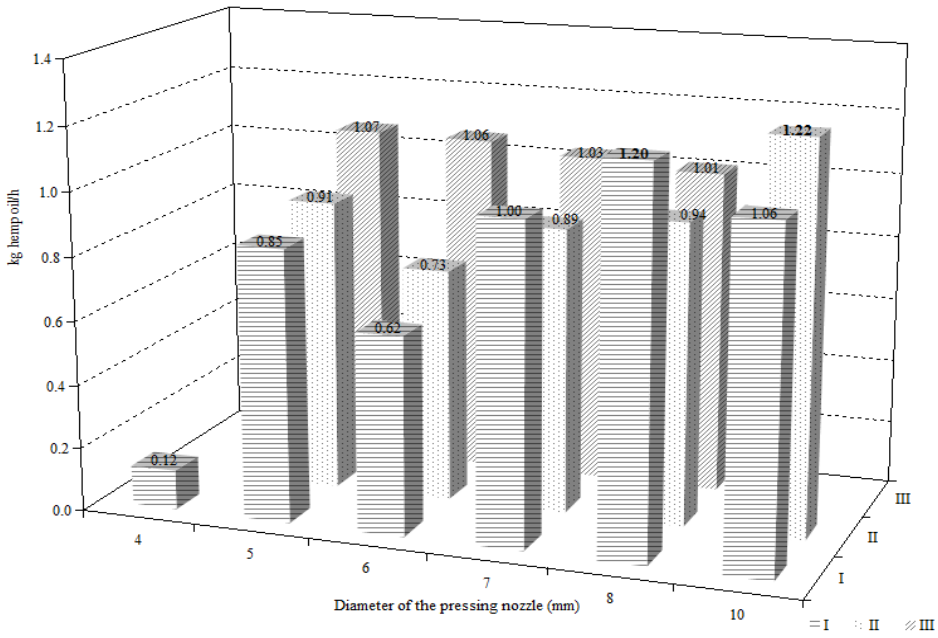

Fig. 2. Press productivity (quantity of hemp oil in kg processed in one hour)

The acidity values, expressed in mg KOH/g oil and oleic acid (%), as well as the peroxide values of some of the cold pressed hemp oils are presented in the Tab. 4.

Tab. 5

The acidity values and the peroxide values of the hemp oil obtained by cold pressing with the screw press with different press nozzle of diameter of ϕ: 4, 5, 6, 7, 8 and 10 mm

Crt. No.	Sample specification	ϕ (mm)	Free acidity of the oils		Peroxide value mEq O_2/g
			mg KOH/g oil	Oleic acid (%)	
1.	Hemp oil I^2	5	0,65	0,33	n.d.
2.	Hemp oil I^2	6	1,95	1,00	0,62
3.	Hemp oil I^2	7	2,83	1,46	1,50
4.	Hemp oil II	5	0,65	0,34	n.d.
5.	Hemp oil II	6	0,77	0,39	7,49

6.	Hemp oil II	7	0,74	0,38	26,91
7.	Hemp oil III	4	7,42	3,82	n.d.
8.	Hemp oil III	5	4,34	2,23	n.d.
9.	Hemp oil III	6	4,45	2,29	17,28
10.	Hemp oil III	7	4,21	2,16	19,41

[2]- values of the acidity after 6 month of the pressing, respectively storage of the oil; n.d.- not determined

The acid values of the hemp oil was between 0,65 and 4,45 mg KOH/g, excepting one value of 7,42 mg KOH/g oil. The acidity values are comparable with those reported for the hemp oil by the literature (Carvalho, 2006). The peroxide value varied between 0,62 and 26,91 mEg O_2/g, the lowest one being determined for the oil processed from hemp seed I with a lower total volatile matter content with values under 1,50 mEqO_2/g (the acid values under 3 mg KOH/g oil). Correlating the acidity value with the peroxide value, there was ascertained that only the oil processed from the seeds with lower total volatile content (6,32%) are according to the quality criteria.

CONCLUSIONS

The approach of the technology of oil production from the studied sorts of hemp seed by cold pressing has revealed important principles regarding the practice. There was processed from 100 kg hemp seeds (with 30,89 to 33,25 % fats content and total volatile matter of 6,3 % to 9,58 %) between 23,89 and 27,69 kg oil, depending on the diameter of the press nozzle attached to the screw press. The efficiency of process was provided by the press productivity with optimal values of 1,20 and 1,22 kg hemp oil processed per hour. The results are providing also information regarding the possibility of varying of the pressing process, in order to achieve by products with foreseen composition. The hemp seed pressing cake can be classified into the category of functional products, due to their, also, valuable nutritional properties. The study of hemp oil composition pointed out its alimentary and therapeutic qualities, provided by the high polyunsaturated fatty acids and the ideal rate of the essential fatty acids ω-6:ω-3 of 3:1. Further studies are necessary in order to analyse the composition of the hemp oil processed from hemp seed cultivated in Romania.

With regard to the realized researches, we recommend also the initiation of an information programme addressed to the consumer and to the farmers concerning new acknowledgements of the importance of the hemp culture, as well as the importance of the processed products

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