A COMPARATIVE STUDY OF SOME CANOLA SEED CULTIVARS

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Abstract

A local cultivar (Cerro-4) of canola seed was evaluated in comparison with two foreign cultivars (Pactol and Canadian) cultivated in Egypt. The oil content, protein, crude fiber, ash and total carbohydrate of Cerro-4 seeds of cero seeds were 38, 22.37, 10.55, 6.20 and 15.46%, respectively. This composition was nearly similar to Pactol cultivar, but it was differente from the Canadian cultivar.

Fatty acid analysis by GC-capillary column indicated that the erucic acid of the local cultivar (1.84%) was lower than that of the Canadian cultivar (19.3%), but it was nearly similar to Pactol cultivar (1.64%). The glucosinoles estimated by HPLC, was found to be 22.52, 20.65 and 37.19 μM/gm meal in Cerro-4, Pactol and Canadian cultivars, respectively.

Natural antioxidant (Tocopherol, B-carotene, polyphenols and Unsapenifiable matter) of local cultivar canola seed oil were 134.5, 8.41 and 23.03 ppm and 2.31%, respectively.

Canola oil (Cerro-4) was blended with cotton seed oil at different percentage to reduce erucic acid content. The blend of 25% of canola seed oil (Cerro-4) with 75 percent cotton seed oil seems to give a level of erucic acid to 0.44%, which will increase its safe use.

Key words: Canola seed oil, chemical composition, physical and chemical properties, natural antioxidant, fatty acid composition and glucosinolates

INTRODUCTION

Canola is one of the most important oil seed crops in the world, the fatty acid composition of canola oil is especially favorable in terms of health benefits when used as part of a nutritionally balanced diet: it has a very low concentration of saturated fat (only 7%) relatively high in monounsaturated fat, among the highest in omega-3 FA (10-11%), and contains a moderate level of polyunsaturated fat (32%) (Manochehri, et al., 2005).

Canola seed is expected to have less than 20 mg erucic acid/g oil by definition and the trade expects less than 10mg/g oil in their standards. In addition. Canola is defined as seed with less than 18 μM/g glucosinolates (Daun, 2004).

Over the last years, the production of oil seed with especially fatty acid profiles has increased. Canola (low erucic acid rapeseed) cultivars have been developed with high oleic acid and/or low linolenie acid (Bert and Daun, 2005).

Much Canadian canola is marketed in both Canada and the USA as being low in saturated fatty acids. In order to meet the labeling requirements for this claim, the oil must contain less than 70 mg saturated fatty acid/g oil. Acheiving this level has become difficult in Western Canada as the proportion of low saturated fatty acid (Brassica rapa) has decreased (Daun and Declereq, 1998).

Linolenic acid is the key polyunsaturated fatty acid in canola oil. Low level of this fatty acid is desired in order to improve oxidative stability of the oil (Daun, 2004).

In Egypt there is a great interest in growing rapeseed, but only some field trials were carried out (Ibrahim et al., 1989).

The seed oil from a genetically transformed canola (Brassica napus) contains 43% γ-linolenic acid, 22% linoleic acid and 16% oleic acid (Jaim – Wen Liu *et al.*, 2001).

The direction toward lower linolenic acid, higher oleic acid and higher saturated fatty acids seems appropriate because oils with these fatty acid profiles have greater frying stability as judged by less oxidation, polymerization and hydrolsis (Warner et al., 1994).

List et al. (1983) studied the possibility of using 75% rapeseed oil in blended oils to reduce erucic acid content.

The present study compares the chemical composition of the seeds and the quality of oil for the local cultivar canola seed (Cerro-4) with Pactol and Canadian cultivars.

MATERIALS AND METHODS

Materials

1. Canola seed

Two foreign varieties of canola seed (Pactol and Canadian) which are cultivated in Egypt and a local cultivar of canola seed (Cerro-4) were studied.

All varieties of canola seeds were obtained from the Agricultural Research Center, field crops institute, oil Crops Department, Giza.

2. Cotton seed oil

Cotton seed oil was obtained from local supermarkets.

3. Blended oils

Consist of cottonseed oil blended with canola oil (Cerro 4 var.) at different percentages:

1. Canola oil (Cerro-4) was added in the concentration of 25% to cotton seed oil (blend 1).
2. Canola oil (Cerro-4 var.) was added in the concentration of 50% to cotton seed oil (blend 2).
3. Canola oil (Cerro-4 var.) was added in the concentration of 75% to cotton seed oil (blend 3).

Methods

- Extraction of crude oil by pressing:

The canola seeds were packed in cheese cloth then pressed by using hydraulic laboratory (Craver) press. The separated oil was dried over anhydrous sodium sulphate, then filtered through a Whatman filter paper No.1 and kept in a brown glass bottle (120 ml) at 5 °C until analysis.

- Analytical methods

1. The moisture content, total lipids, crude protein crude fibers and ash were determined according to the method described in the AOAC (1990).
2. Determination of total hydrolysable carbohydrates. Total carbohydrates were determined according to the method reported by Dubois et al. (1960).
3. Refractive index at 25°C, free fatty acid (as oleic percent), peroxide value (as mille equivalent/ kg oil), iodine value, unsaponifiable matter percentage and β-carotenes were determined according to the methods described in the AOAC (1990).

4. Absorbancy in ultraviolet

The U.V. absorption of 1% solution of the oil in cyclohexane in 1 cm cuvet was measured according to FAO/WHO (1970), at 232 and 270 nm using Shemadzu Spectrophotometer (U.V. Vis 120-02).

5. Colour

A Lovibond Tintometer was used to measure the colour using 6-25 inch cell according to the method of the AOAC (1990).

6. Determination of total tocopherols

The total tocopherols content in canola seed oil was determined according to the method of Wong et al. (1988).

7. Determination of total polyphenols

The total polyphenols was determined according to the method reported by Gutfinger (1981).

8. Fatty acid composition of the oil

The fatty acid of the analysed oil samples were determined by GC-capillary column according to the method reported by IOOC (2001).

9. The stability of oil

The oxidative stability of canola seed oil was estimated using a 679 Rancimat (Metrohn Herisou, Co., Switzerland) at 100°C with an air flow rate of 20 l/hr according to the method described by Mendez et al. (1997).

10. Glucosinolates Activity in Meal

Glucosinolates content was determined by HPLC according to the method reported by Maheshwari et al. (1980).

RESULTS AND DISCUSSION

1. Chemical composition of three canola seed cultivars.

Three cultivars of canola seed cultivated under Egyptian conditions and were analyzed for chemical composition. The results are shown in Table (1). Moisture contents of canola seeds, local variety (cerro-4) and two foreign varieties (Pactol and Canadian) were 7.06, 7.61 and 5.90% respectively.

From the same table, it could be noticed that the Canadian cultivar has the highest oil content (44.51%) followed by Pactol cultivar (40.05%) and finally Cerro-4 cultivar (38.0%). Besides the obtained results in Table (1) indicate that the crude protein of Canadian cultivar recorded the highest content (24.32%) followed by Cerro-4 cultivar (22.73%) and Pactol cultivar (22.2%).

On the contrary the seed of local cultivar (Cerro-4) recorded the highest content of total carbohydrates, crude fiber and ash content (15.46, 10.55 and 6.20%) compared with Canadian cultivar (13.0, 8.43 and 3.84% respectively). These results are in agreement with those obtained by (Nahed 2000).

The obtained results in the same table showed that the Canadian variety has the highest glucosinolates content in meal (37.19 μM/g meal) followed by Cerro-4 cultivar (22.52 μM/g meal), and Pactol cultivar (20.65 μM/g meal). These results are in agreement with those obtained by (Maheshwari et al., 1980).

Table 1.Chemical composition of three varieties of canola seeds.

Chemical composition (%)	Varieties		
	Cerro-4	Pactol	Canadian
Mositure content	7.06	7.61	5.90
Crude oil	38.00	40.05	44.51
Crude protein	22.73	22.20	24.32
Crude fiber	10.55	9.28	8.43
Ash content	6.20	3.70	3.84
Total hydrolysable carbohydrates	15.46	15.16	13.00
Glucosinolate (μM/g meal)	22.52	20.65	37.19

Data in table (2) shows that the physical and chemical properties of crude oils extracted from the three cultivars of canola cultivated in Egypt, Pactol var, Canadian var. and Cerro-4 (local var.). It is clear from these data that the three varieties had nearly the same value for red colour, stability, K_{232} and K_{270}, while the refractive index and the free fatty acids of the Canadian oil cultivar were lower than those of the Pactol and Cerro-4 cultivar; but its iodine value was higher than the other varieties.

Table 2. Physical and chemical properties canola of seed oil.

Properties	Varieties		
	Cerro-4	Pactol	Canadian
Refractive index at 25C°	1.4710	1.4709	1.4210
Color Yellow	35	35	35
Red	3.9	3.9	4.3
Blue	-	0.2	0.1
Free fatty acid (%)	0.52	0.49	0.32
Peroxide value (meq/kg oil)	2.33	4.33	4.35
Iodin value (I2/100g oil)	100.2	103	111.73
Stability (hr.) at 100°C	10.5	10.75	10.13
Uv-absorbance at 232 nm	0.40	0.39	0.41
Uv-absorbance at 270 nm	0.103	0.107	0.136

Table 3. Natural antioxidant of Canola.

Natural antiodent	Varieties		
	Cerro-4	Pactol	Canadian
Total tocopherols (ppm)	134.5	172.0	110.21
B-carotens (ppm)	8.41	6.62	3.62
Total polyphenols (ppm)	23.03	18.23	16.47
Unsap (%)	2.13	1.95	1.84

Natural antioxidant of canola oil

Results tabulated in Table (3) show the natural antioxidant, (total tocopherol, B-carotens, total polyphenols and unsaponifiable matter of the three varieties of canola oils. These results indicate that Cerro-4 cultivar, had the highest content of B-carotenes, total polyphenols and unsaponifiable matter (8.41 and 23.03 ppm and 2.13 % respectively) than the two foreign varieties, 6.62 and 18.23 ppm and 1.95% for Pactol cultivar and 3.62 and 16.47 ppm and 1.84% for (Canadian var.), respectively while, the total tocopherols of Pactol variety recorded the highest content (172 ppm), followed by Cerro-4 cultivar (134.5 ppm) and finally the Canadian variety was (110.2 ppm).

Fatty acid composition of Canola oils

The data tabulated in Table (4) illustrated the fatty acid composition of Cerro-4, Pactol and Canadian cultivars. Regarding to erucic acid it was lower than 2% in the Cerro-4 and Pactol cultivars but it was 19.3% in the Canadian cultivar. Concerning total saturated FA, it ranged from 4.87 - 7.68%, meanwhile total unsaturated FA ranged from 92.32 to 95.13% for the three cultivars. Oleic acid was the major unsaturated fatty acid in the three cultivar it ranged from 41 to 68.42% the highest content of oleic acid was noticed in Pactol cultivar (68.42%) followed by Cerro-4 and Canadian cultivar. Palmitic acid was the major saturated fatty acid in the three cultivars. These results are in agreement with those obtained by (Nahed, 2000).

Table 4.Fatty acid composition of Canola oils.

Fatty acid (%)	Varieties		
	Cerro-4	Pactol	Canadian
$C_{16:0}$	4.47	4.04	6.5
$C_{16:1}$	0.40	0.10	0.30
$C_{18:0}$	2.53	0.07	0.75
$C_{18:1}$	57.03	68.42	41.00
$C_{18:2}$	21.23	16.12	26.85
$C_{18:3}$	8.87	7.06	5.30
$C_{20:0}$	0.68	0.76	-
$C_{20:1}$	2.94	1.64	0.75
$C_{22:1}$	1.84	1.64	19.3
Total saturated F.A.	7.68	4.87	7.19
Total unsaturated F.A.	92.32	95.13	92.81

Physical and chemical properties of blended oils

The changes in physical and chemical characteristics of cotton seed oil as a result of blending with different levels from canola seed oil (Cerro-4 variety) 25, 50 and 75% are tabulated in Table (5). Data indicated that the stability of blended samples increased as a result of blending by Canola oil (Cerro-4 var.) while peroxide value, Iodine value, UV absorbance at (232 nm. and 270 nm.) and color decreased gradually with the increased amount of canola seed oil in the blends. From the above data in this table, the addition of 25, 50 and 75% of canola seed oil to cotton seed oil improve the physical and chemical characteristics of the blended samples.

Table 5. hysical and chemical characteristics of cotton seed oil and its blendes with canola oil (Cerro-4 var.)

Physical and chemical properties	Cotton seed oil	B (1)	B (2)	B (3)
Refractive index at 35°C	1.4724	1.4727	1.4730	1.4733
Color : Yellow	35	35	35	35
Red	5.6	5.2	4.4	3.8
Free fatty acid (%)	0.45	0.55	0.52	0.46
Peroxide value (meq/kg oil)	3.46	2.40	2.37	2.31
Iodine value (I_2/100g oil)	115.01	111.20	110.43	108.28
Stability (hr.)	9.03	9.33	9.50	10.01
UV absorbance at 232nm.	0.89	0.82	0.74	0.67
UV absorbance at 270nm.	0.15	0.14	0.13	0.12

Fatty acid composition of blended oils

Canola oil was blended with cottonseed oil for two purposes firstly to decrease the level of erucic acid to minimum level and secondly to decrease the level of linolenic acid content to improve stability.

From the tabulated results in Table (6) and Fig (1 and 2) it is clear that the level of erucic acid was the lowest in blend (1) (0.44%) and also linolenic acid content decreased in the same blend to 2.29% compared with 8.87% in the canola oil of Cerro-4 cultivar. These Results agreed with those reported by List et al., 1983.

Table 6. Fatty acid composition of blended oils

Fatty acid (%)	Cotton seed oil	Canola oil Carro4	B (1)	B (2)	B (3)
$C_{16:0}$	25.07	4.47	19.85	14.44	9.93
$C_{16:1}$	0.79	0.4	0.66	0.51	0.39
$C_{18:0}$	2.74	2.53	2.53	2.26	2.06
$C_{18:1}$	20.94	57.03	30.40	38.72	47.94
$C_{18:2}$	49.56	21.23	41.91	36.63	28.96
$C_{18:3}$	0.21	8.87	2.29	4.42	6.51
$C_{20:0}$	0.44	0.68	0.50	0.56	0.62
$C_{20:1}$	0.25	2.94	0.79	1.55	2.24
$C_{22:1}$	-	1.84	0.44	0.91	1.35
Total saturated	8.25	7.68	22.88	17.26	12.61
Total unsaturated	71.75	92.32	77.12	82.74	87.39

From this study it could be noticed that the Egyptian cultivar has similar characteristics and chemical composition to the two foreign cultivars and it could be recommended to blend canola oil with cottonseed oil to minimize the level of erucic acid and increase the stability of the blend by decreasing the level of linolenic acid.

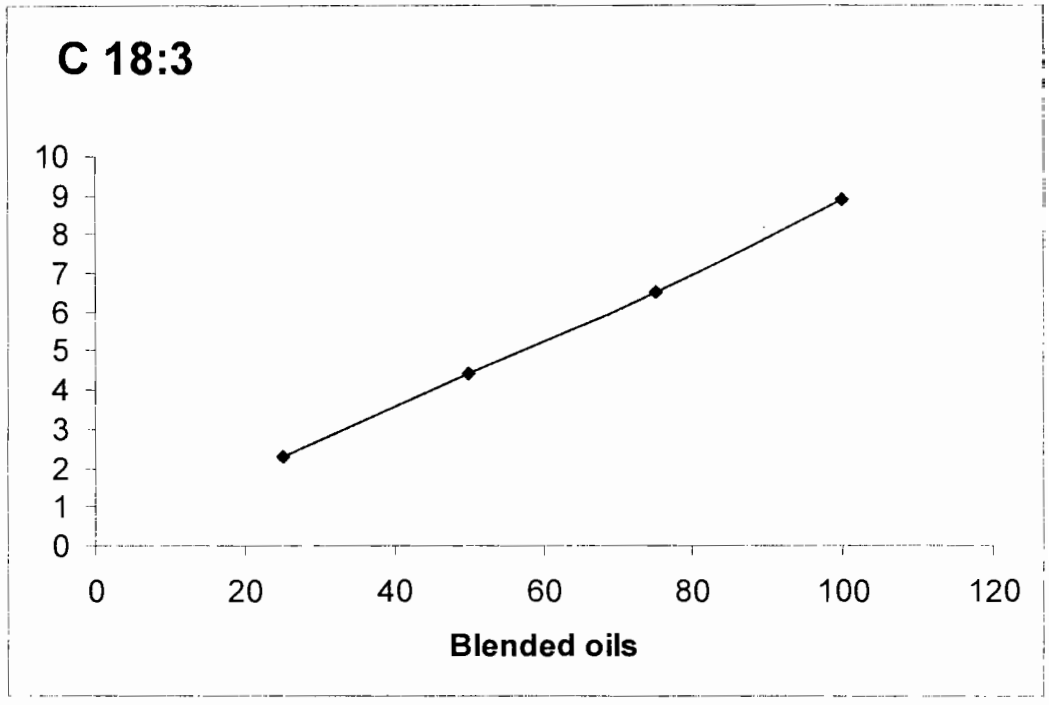

Fig. 1. Relation between C 18:3 and different percentages of blended oils

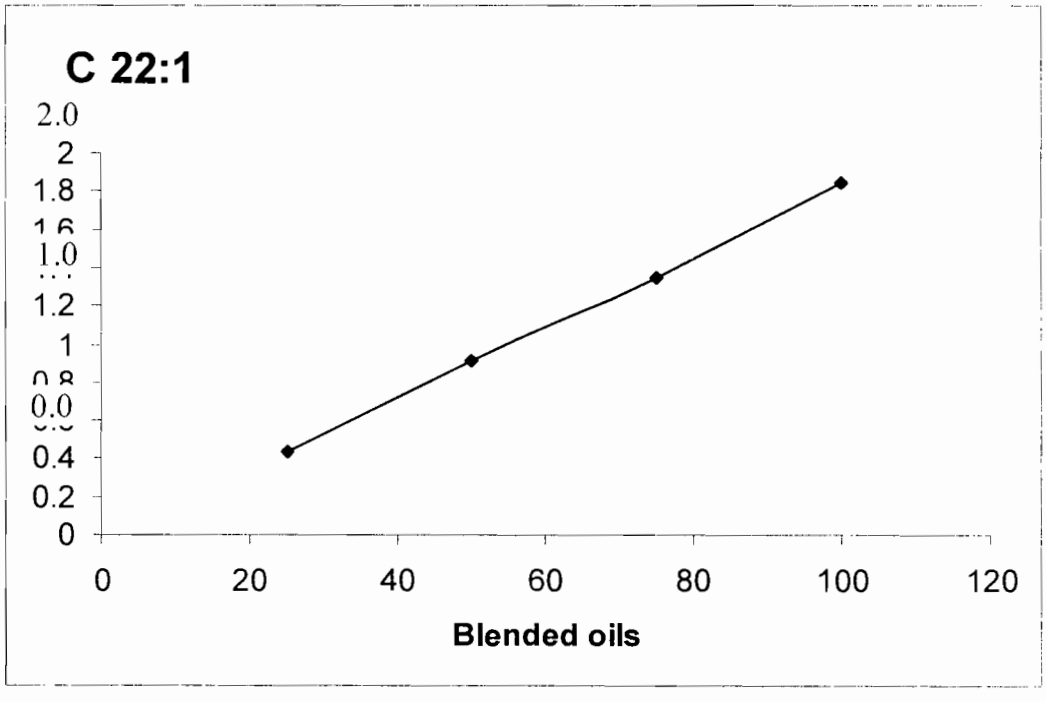

Fig. 2. Relation between C 22:1 and different percentages of blended oils

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دراسة مقارنة لبعض أصناف بذور الكانولا

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تم تقييم صنف محلى من بذور الكانولا (سيرو-٤) بالمقارنة لصنفين مستوردين (Pactol and Canadian vars.) واتضح من النتائج الآتى:

- التركيب الكيميائى لصنف (سيرو-٤) ؛ محتوى الزيت ، البروتين والأليـاف، والرمـاد والكربوهيدرات كانت ٣٨ ، ٢٢,٢٧ ، ١٠,٥٥ ، ٦,٠٢ ، ١٥,٤٦% على التوالى وكان هذا التركيب الكيميائى تقريبا نفس التركيب الكيميائى للصنف باكتول ولكنه كان يختلف مع الصنف الكندى.

- كما أشار التحليل الكيميائى للأحماض الدهنية بواسطة GC-Capillary أن نسبة حمض الأيروسيك للصنف المحلى كانت منخفضة ١,٨٤% مقارنة بالصنف المستورد Canadian var. (١٩,٣%) ولكنها كانت تقريبا نفس النسبة للصنف باكتول (١,٦٤%)، كما تم تقدير نسبة الجلوكوزنيولات بواسطة HPLC وقد وجد أن نسبة الجلوكوزنيولات كانت (٢٢,٥٢ ، ٢٠,٦٥ ، ٣٧,١٩ ميكرمول/ جم كسبة) فى الأصناف سيرو-٤ ، باكتول وكندى على التوالى.

- وكانت نسبة مضادات الأكسدة الطبيعية (توكوفيرول ، بيتاكاروتين، فينولات، مواد غير قابلة للتصبن لزيت الكانولا صنف (سيرو-٤) ١٣٤,٥ ، ٨,٤١ ، ٢٣,٠٣ جزء فى المليون، ٢,١٣% على التوالى.

- كما تم خلط زيت بذور الكانولا (سيرو-٤) مع زيت بذور القطن بتركيزات مختلفة لنقص نسبة حمض الأيروسيك ، وقد أعطت نسبة الخلط ٢٥% كانولا مع ٧٥% زيت بذور القطن الحدود المسموح بها من حامض الأيروسيك وذلك لزيادة الاستخدام الآمن.