RESULTS AND DISCUSSION

3.1 Chemical Composition of Rapeseed Varieties:

Fourteen samples of whole rapeseed, from a variety of geographical origins, were analyzed for chemical composition. The results are shown in Table (5).

Moisture contents of different rapeseed varieties ranged from 7.45% (Cresor variety) to 8.40% (Ro Meo T variety). However, the initial moisture content is certainly important if the seed are going to stored for long periods.

Lipid content of rapeseed varieties ranged from 40.20% (Hanna) to 44.96% (Hohenheimer). These results in agreement with that obtained by **Marianchuk *et al.* (1987).**

Crude protein contents of rapeseed samples showed that Hanna variety contains 24.16% as the highest ones. While Bruter variety contains 20.30% is lower than of the other varieties. The amount of crude protein content, which ranged between 20.30% to 24.16% was similar with that reported by **Mills *et al.* (1987).**

Total carbohydrates in rapeseed varieties ranged from 18.50% (Hohenheimer) to 24.50% (Cloza). These results are within the range of the obtained results by **DeClereq *et al.* (1992).**

Ash content of fourteen varieties rapeseed showed that the varieties Cresor, Hanna, Brutor 95C and Cloza were high in ash content 5.27%, 5.15%, 5.10% and 5.10% respectively than the other varieties. While, ash

Table (5) : Chemical composition and elements of different rapeseed varieties.

No.	Varieties *Brassica napus*	Composition (%)					Elements (%)								
		Moisture content	Oil content	Protein content	Total carbohydrate	Ash	Na	K	P	Ca	Mg	Cu	Fe	Mn	Zn
1	Hohenheimer	7.96	44.96	23.28	18.50	4.82	0.021	0.792	0.490	3.316	4.579	0.0038	0.0035	0.0031	0.0084
2	Weibub	8.04	42.65	22.53	21.90	5.00	0.015	0.844	0.433	3.316	6.044	0.0041	0.0039	0.0035	0.0077
3	Cloza	8.23	40.80	20.98	24.50	5.10	0.036	0.866	0.450	2.296	5.492	0.0039	0.0040	0.0031	0.0085
4	Ro Meo T	8.40	41.91	21.80	22.90	4.87	0.028	0.700	0.453	2.041	4.914	0.0042	0.0064	0.0028	0.0084
5	Brutor 95C	8.13	43.50	20.27	23.08	5.10	0.028	0.837	0.775	5.867	4.494	0.0045	0.0077	0.0025	0.0077
6	Orpal 95C	7.89	41.80	21.98	22.89	4.84	0.036	0.740	0.448	2.296	5.199	0.0038	0.0069	0.0029	0.0076
7	Altex	8.09	43.03	22.15	22.05	4.80	0.034	0.828	0.415	1.786	6.558	0.0043	0.0055	0.0034	0.0053
8	Regent	8.04	43.70	20.54	23.25	4.52	0.021	0.777	0.300	2.296	5.932	0.0041	0.0085	0.0041	0.0080
9	Tower	7.96	42.79	21.88	21.97	4.94	0.030	0.825	0.338	3.882	4.847	0.0035	0.0068	0.0024	0.0078
10	Niklas	8.39	42.91	21.02	22.80	4.90	0.021	0.972	0.395	2.296	5.199	0.0034	0.0082	0.0034	0.0085
11	Brutor	7.89	44.16	20.30	22.95	4.88	0.026	0.863	0.398	2.806	5.622	0.0037	0.0070	0.0033	0.0076
12	Cresor	7.45	41.84	22.85	22.50	5.27	0.015	0.779	0.335	2.296	7.543	0.0042	0.0093	0.0032	0.0068
13	Hanna	7.72	40.30	24.16	22.60	5.15	0.024	0.902	0.325	2.551	4.449	0.0040	0.0074	0.0026	0.0057
14	Active	7.85	41.87	22.67	22.75	4.90	0.026	0.872	0.300	2.041	6.673	0.0041	0.0056	0.0032	0.0071

content of other varieties lies between 4.80% to 5.00%. This results may be due to that the Cloza, Hanna and Brutor 95C varieties contain a higher amount of K^+ and Na^+ ions as shown in Table (5) which may be due to the variations of climate or fertilizer treatments. Generally, these results as similar to those obtained by **Bell and Shires (1983).**

3.1.1 Minerals Constituent of Rapeseed Varieties:

The ash of different rapeseed varieties were analyzed to show their main minerals, the obtained results are presented in Table (5). The determined minerals included Na, K, P, Ca, Mg, Cu, Fe, Mn and Zn. These results represent that all varieties are relatively high in its content of Na, K, P and Ca. While Cloza and Regent varieties contain high percent amount of Zn such values resembles (0.0085%) and (0.0080%) and Fe (0.0082%) and 0.0085% respectively. These results are almost in agreement with those established by **Burton (1983).** From the above results it clear that the rapeseed is good source of minerals such as K, P, Ca, Mg, Fe, Mn and Zn, **Clandinin (1986).**

3.1.2 Amino Acid Composition of Rapeseed Varieties:

The data concerned with the amino acid composition of the fourteen rapeseed varieties (Table 6) clearly indicate that glutamic, asparatic and prolein acids are the most abundant amino acids in all varieties, followed by lys and leu+isoleu.

Histadine is present in minute quantities in all varieties with average range 0.42 to 0.73 g/100g protein.

Table (6) : Amino acid composition of different rapeseed varieties.

No.	Varieties *Brassica napus*	Amino acids %														Total amino acids
		EAA						Non EAA								
		Lys	Leu +Ile	Met +Cys	Phe +Tyr	Thr	Val	His	Arg	Asp	Glu	Ser	Pro	Gly	Ala	
1	Hohenheimer	1.04	1.83	1.14	0.99	0.79	0.62	0.57	0.71	1.30	3.85	0.70	1.45	0.88	0.76	16.63
2	Weibub	1.20	2.71	0.96	1.61	0.83	0.93	0.58	0.99	1.28	4.27	0.64	1.62	1.00	0.85	19.47
3	Cloza	1.09	1.89	1.04	0.76	0.81	0.84	0.50	1.03	1.30	3.87	0.75	1.24	0.94	0.82	16.79
4	Ro Meo T	1.04	1.74	1.24	0.91	0.74	0.79	0.50	0.72	1.22	3.64	0.63	1.22	0.86	0.75	16.00
5	Brutor 95C	0.99	1.80	1.29	0.95	0.70	0.78	0.54	0.80	1.18	3.29	0.51	1.40	0.85	0.75	15.83
6	Orpal 95C	1.23	2.20	1.27	1.24	0.89	0.95	0.58	0.86	1.27	4.28	0.83	1.91	1.10	0.92	19.53
7	Altex	1.04	1.86	1.01	0.87	0.74	0.83	0.59	0.96	1.39	3.41	0.71	1.20	0.96	0.85	16.42
8	Regent	1.07	1.99	1.17	1.08	0.78	0.84	0.51	1.20	1.40	3.92	0.72	1.65	0.91	0.79	18.03
9	Tower	1.27	2.30	1.08	1.23	0.87	0.98	0.71	1.12	1.57	4.75	0.78	2.44	1.05	0.96	21.11
10	Niklas	1.26	3.48	1.20	2.94	0.98	1.02	0.66	1.49	1.82	5.06	1.00	2.52	1.22	1.03	25.68
11	Brutor	1.24	2.81	1.20	1.82	0.92	0.96	0.61	1.19	1.58	4.52	0.88	2.27	1.03	0.96	21.99
12	Cresor	1.20	2.58	1.22	1.57	0.89	0.94	0.62	1.14	1.52	4.42	0.86	---	1.00	0.91	18.87
13	Hanna	1.27	2.41	1.16	1.32	0.98	1.01	0.73	1.27	1.72	4.96	0.96	2.52	1.09	0.99	22.39
14	Active	0.86	1.74	0.76	1.03	0.64	0.64	0.42	1.22	1.27	3.27	0.66	1.65	0.72	0.65	15.53

The reported data for the relative amino acid composition of the fourteen varieties agreed very closely with that reported by **Barbour and Sim (1991), Zuprizal *et al.* (1993) and Hafermann *et al.* (1993).**

From the data presented in Table (6) its clear that the essential amino acid pattern of Brutor 95C and Ro Meo T are higher in sulpher amino acid i.e. cystine and methionine, 1.29 and 1.24g/100g protein respectively.

On the other hand, Tower, Hanna and Niklas varieties contain high quantities of lysine 1.27, 1.27 and 1.26g/100g protein respectively and adequate quantities of (Phe+Tyr), i.e. 1.82 and 1.57g/100g protein for Brutor and Cresor respectively.

The amino acid composition of 14 rapeseed varieties under investigation and its E/N and E/T are introduced in Table (7).

Niklas and Hanna contain the higher total amino acids 25.68 and 22.39 and higher essential amino acids 10.88 for Niklas and 8.95 for Brutor, respectively. While Active seed contain the lower total and essential amino acids (15.53 and 5.67g/100g nitrogen). On the other hand, by comprising the ratios of E/N and E/T, Cresor seed contains the higher ratios (80.2 and 44.5) while Hanna seed contain the lower ratios (57.2 and 36.4).

From the above mentioned results it's clear that the rapeseed is one of the leading potential sources of food protein ingredients based on the production capacity of the crop and the nutritional value of the protein. Interest in rapeseed as a protein source materialized when it become generally appreciated that the essential amino acid composition of rapeseed protein **(Jones, 1979).**

Table (7): Total amino acid (TAA), essential amino acid (EAA), non essential amino acid (NEAA), E/N and E/T.

No.	Varieties *Brassica napus*	TAA	EAA	NEAA	E/N*	E/T**
1	**Hohenheimer**	16.63	6.41	10.22	62.70	38.60
2	**Weibub**	19.47	8.24	11.23	73.40	42.30
3	**Cloza**	16.79	6.34	10.45	60.70	37.80
4	**Ro Meo T**	16.00	6.46	9.45	67.70	40.40
5	**Brutor 95C**	15.83	6.51	9.32	70.00	41.10
6	**Orpal 95C**	19.53	7.78	11.75	66.20	40.00
7	**Altex**	16.42	6.35	10.07	63.10	38.70
8	**Regent**	18.03	6.93	11.10	62.40	38.40
9	**Tower**	21.11	7.73	13.38	57.80	36.30
10	**Niklas**	25.68	10.88	14.80	73.50	42.40
11	**Brutor**	21.99	8.95	13.04	68.60	40.70
12	**Cresor**	18.87	8.40	10.47	80.20	44.50
13	**Hanna**	22.39	8.15	14.24	57.20	36.40
14	**Active**	15.53	5.67	9.86	57.50	36.50

***E/N = Ratio of essential amino acid to non-essential amino acid.**

****E/T = Ratio of essential amino acid to total amino acid.**

3.1.3 Total Glucosinolates and its Individual Components of Rapeseed Varieties:

3.1.3.1 Total Glucosinolates of Rapeseed Varieties:

It is generally known that, measurement of glucosinolate contents in rapeseed became extremely important with the development of new rapeseed varieties with low levels of these nutritionally undesirable compounds.

For this purpose, fourteen varieties of rapeseed (Brassica Napus) were determined for their total glucosinolate contents and identified of individual constituents using GLC. The results presented in Table (8) showed that total glucosinolates content in different varieties under investigation ranged from 20.3 to 85.6 μmol g^{-1}.

The lowest amount of the total glucosinolate was found in Hanna variety, since it possess the value 20.3 μmol g^{-1}. However, appreciable amounts were presented in some of other rape species although not in all of them. On the other hand, varieties of Weibub, Orpal 95C and Altex contained relatively the highest amounts of total glucosinolates. Such values reached 85.6, 73.8 and 81.2 μmol g^{-1} respectively. Our data are in agreement with those reported by **Heaney *et al.* (1988).**

Wetter and Dyck (1973) showed that high concentration of glucosinolates are found especially in seeds, the value reaches up to about 100mg/g dry weight. Moreover, **Olsen and S˙rensen (1980)** demonstrated that the glucosinolate pattern varies considerably within varieties belonging to the same species in different parts of the same plants and during the development of the plant.

Table (8): Total and individual glucosinolate (GS) compounds of different rapeseed varieties (μmol g^{-1}) on dry weight basis.

No.	Varieties *Brassica napus*	3-Butenyl-GS	4-Pentenyl-GS	2-OH-3-Butenyl-GS	2-OH-4-Pentenyl-GS	Allyl-GS	Others P-OH-Benzyl-GS	4-Hydroxy 3-Indolyl Methyl-GS	Total GS
		R.T.* 8.5	9.2	9.7	10.2	7.8	13.5	16.5	
1	Hohenheimer	13.2	4.6	35.9	5.0	1.4	0.6	3.2	58.8
2	Weibub	22.3	5.2	53.6	4.6	0.4	0.0	3.9	85.6
3	Cloza	16.0	3.6	42.3	3.9	0.2	0.1	3.4	65.7
4	Ro Meo T	7.2	1.9	25.7	2.6	0.1	0.0	1.5	37.4
5	Brutor 95C	18.0	2.9	44.1	3.7	0.2	0.0	0.0	68.7
6	Orpal 95C	15.5	5.0	46.1	4.2	0.4	0.1	0.5	73.8
7	Altex	22.8	4.0	50.1	4.3	0.3	0.1	0.4	81.2
8	Regent	7.9	2.2	19.9	2.2	0.1	0.1	0.5	32.3
9	Tower	9.8	3.7	22.3	2.1	0.2	0.6	1.7	37.9
10	Niklas	9.1	3.4	25.2	2.6	0.2	0.2	0.6	40.3
11	Brutor	16.6	2.9	44.4	3.0	0.2	0.2	1.2	67.0
12	Cresor	11.4	5.2	35.5	4.3	0.2	0.6	2.4	55.9
13	Hanna	5.0	1.3	12.2	1.9	0.0	0.0	1.0	20.3
14	Active	8.8	3.4	25.9	4.0	0.1	0.2	3.1	42.3

* Retention time.

3.1.3.2 Individual Components of Glucosinolate of Rapeseed Varieties:

It seems that total (aliphatic plus indolyl) glucosinolate contents provide no information about the nature or relative properties of the individual components. Therefore, trimethylsilylation of glucosinolates of the different seed varieties under study were isolated by ion-exchange chromatography, which their results in derivatives of desulphoglucosinolates were separated and determined quantitatively by GLC.

The glucosinolate constituents of seeds Table (8) and the numbers corresponding to GLC elution peaks are shown in Figs. (3,4,5,6,7 and 8).

The detector response of the derivatized desulphoglucosinolates of the different seed varieties under investigation possessing 3-butenyl, 4-pentenyl-, 2-OH-3-butenyl-, 2-OH-4-pentenyl-, allyl-, *P*-OH-benzyl- and 4-OH-3-indolylmethyl-glucosinolates in Chart (1).

It was noticed that, a comparable quantitative separation of glucosinolate compounds showing a clear distinction between the varieties of rapeseed containing 2-OH-3-butenyl-glucosinolate (progoitrin) as the major compound followed by 3-butenyl-glucosinolate. Moreover, 2-OH-4-pentenyl- and 4 pentenyl-glucosinolates were noticed with relatively similar and lowest amounts, followed by 2-OH-3-indolymethyl glucosinolate. Our finding are similar with those reported by **Daxenbichler *et al.* (1979)** and **Fenwick *et al.* (1983).** They mentioned that 2-OH-3-butenyl-glucosinolate are ubiquitous in Brassica species.

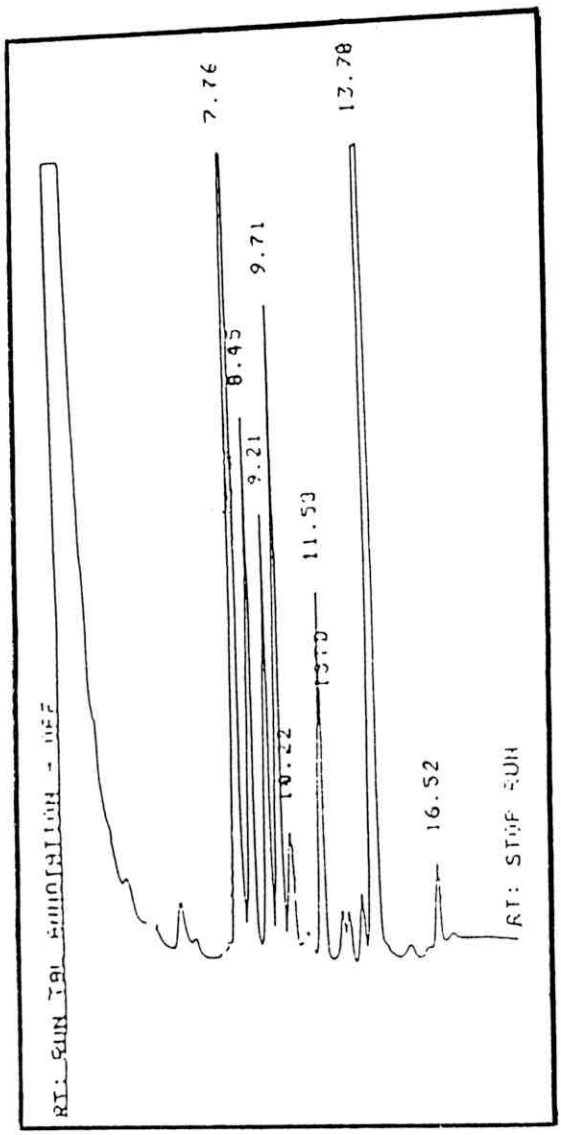


Fig. (3): Retention time (min.) of desulpho-derivatives of glucosinolate standard. ISTD:Allyl- and Benzyl-glucosinolates as Internal Standard (RT. 7.77 and 11.60 min.) respectively.

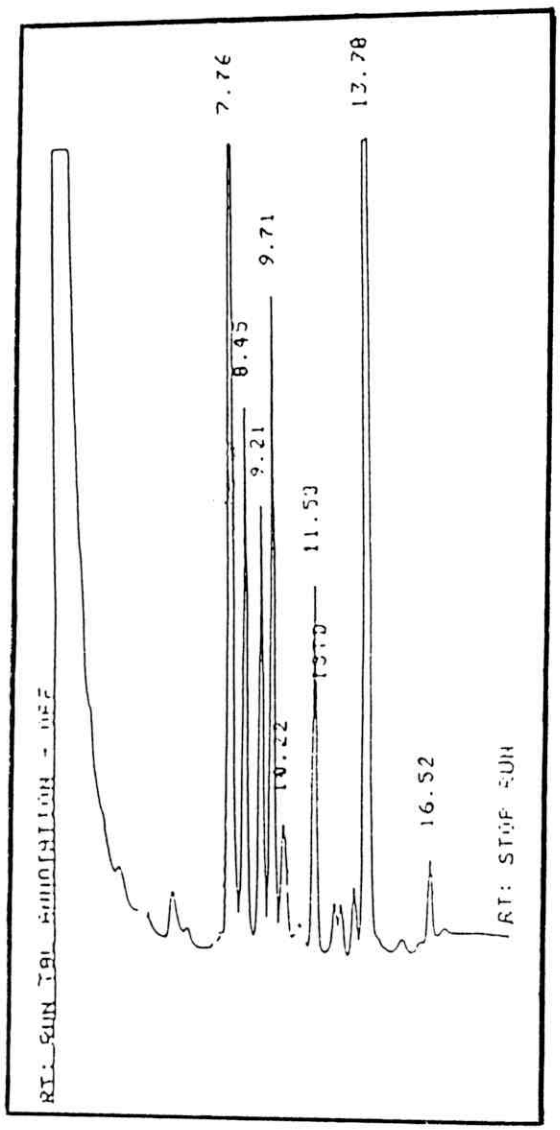


Fig. (3): Retention time (min.) of desulpho-derivatives of glucosinolate standard. ISTD:Allyl- and Benzyl-glucosinolates as Internal Standard (RT. 7.77 and 11.60 min.) respectively.

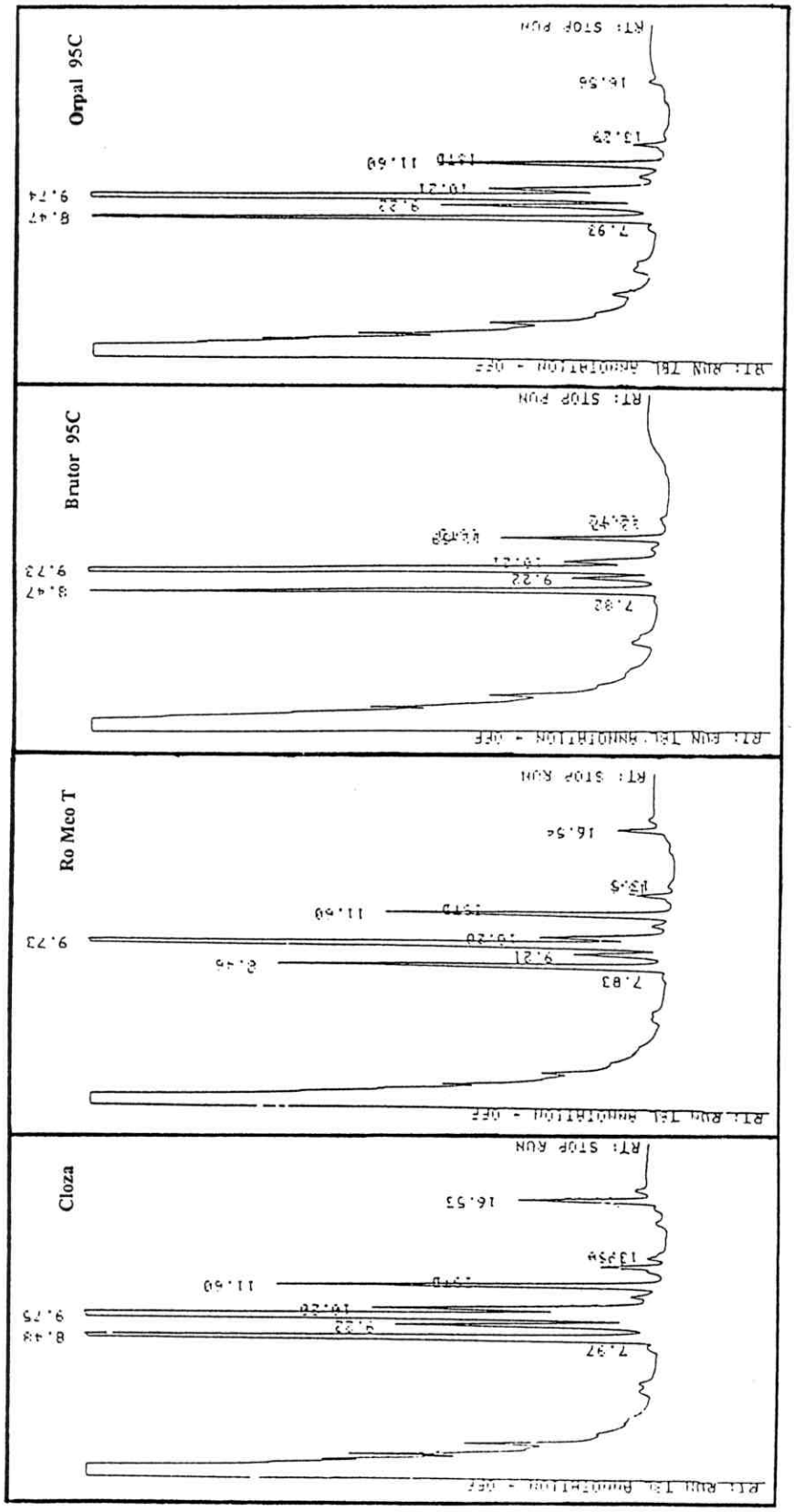


Fig. (5): GLC chromatograms of desulpho-glucosinolate derivatives in rapeseed of Colza, Ro Meo T, Brutor 95C and Orpal 95C varieties.

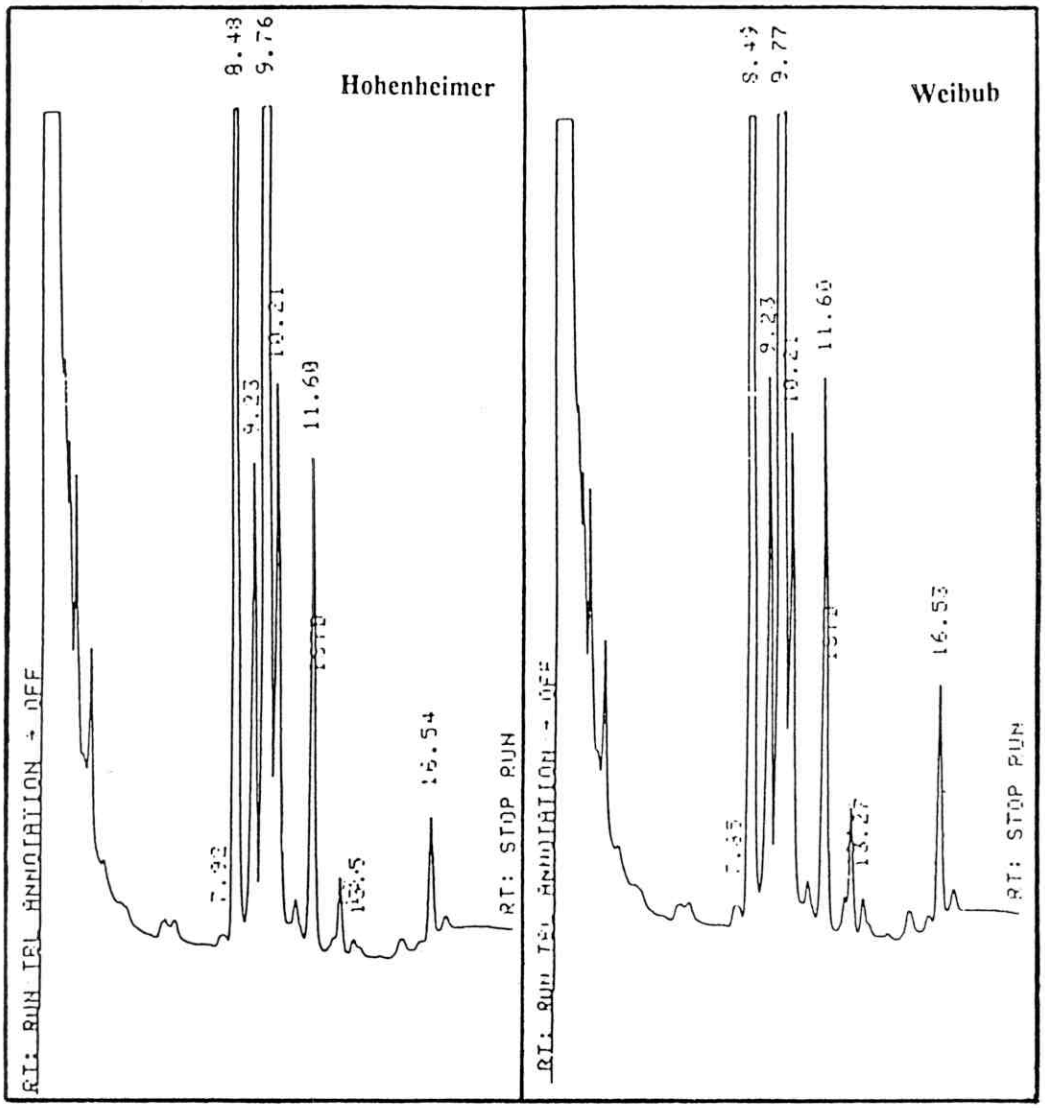


Fig. (4): GLC chromatograms of desulpho-glucosinolate derivatives in rapeseed of Hohenheimer and Weibub varieties.

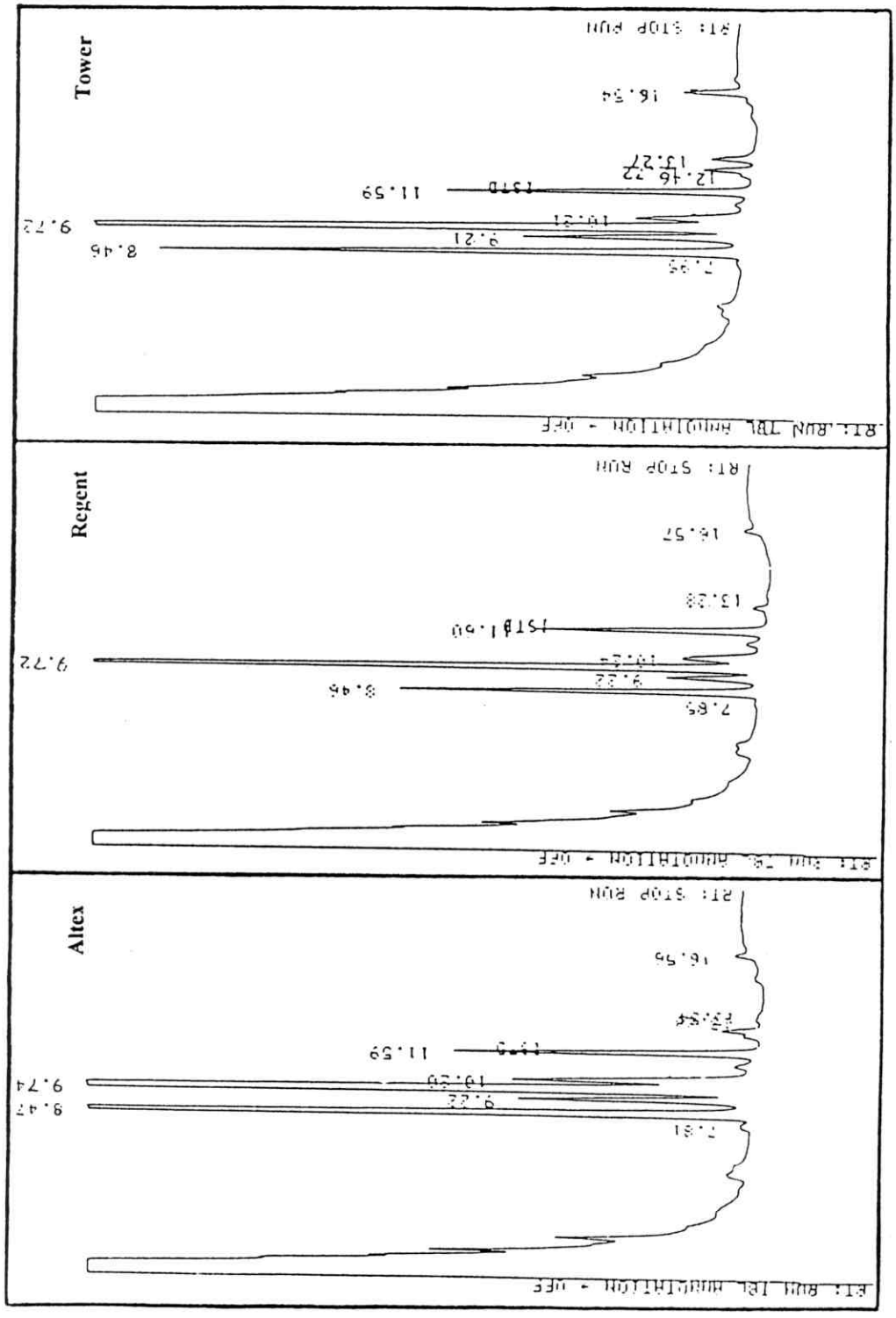


Fig. (6): GLC chromatograms of desulpho-glucosinolate derivatives in rapeseed of Altex, Regent and Tower varieties.

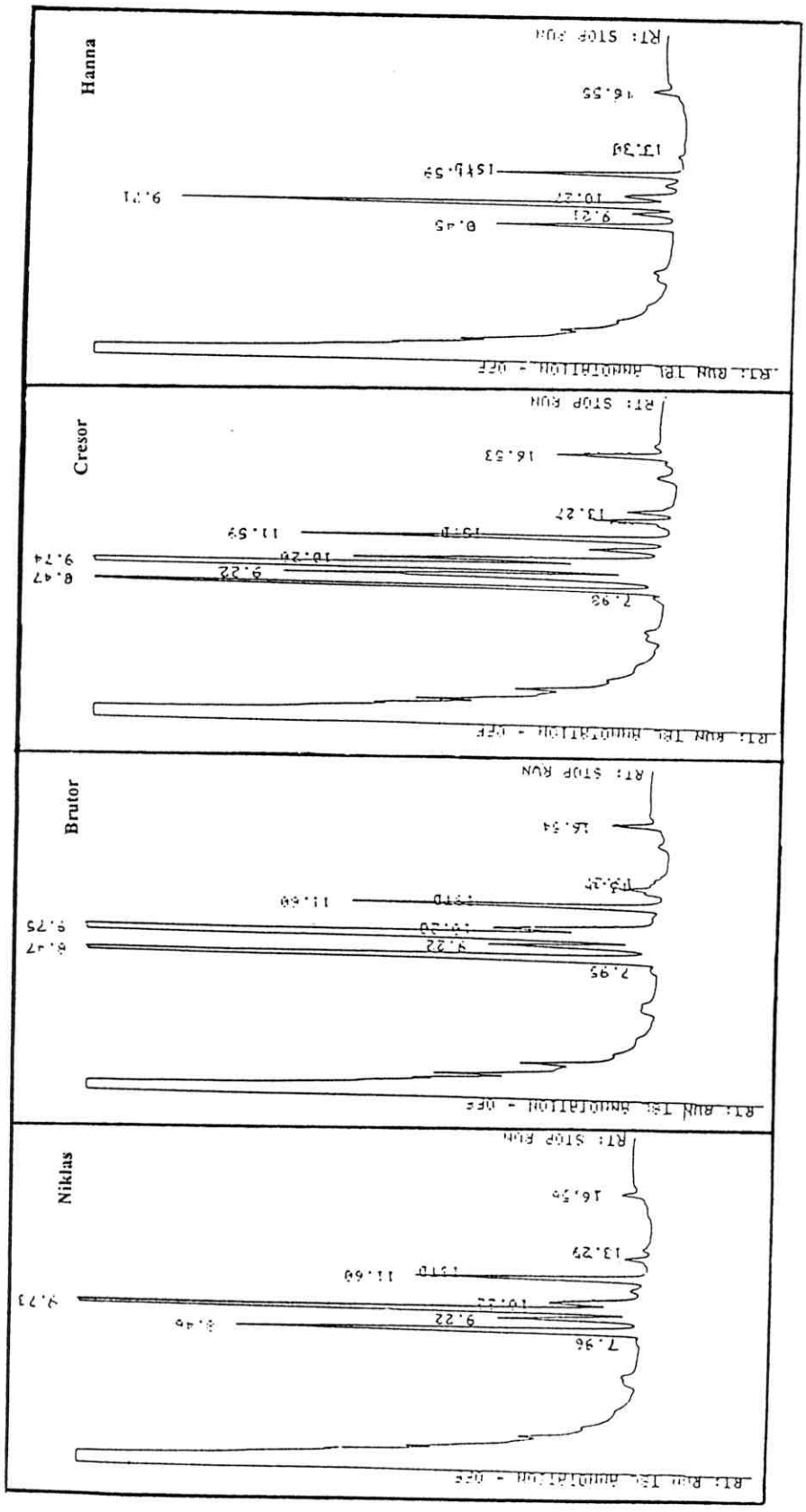


Fig. (7): GLC chromatograms of desulpho-glucosinolate derivatives in rapeseed of Niklas, Brutor, Cresor and Hanna varieties.

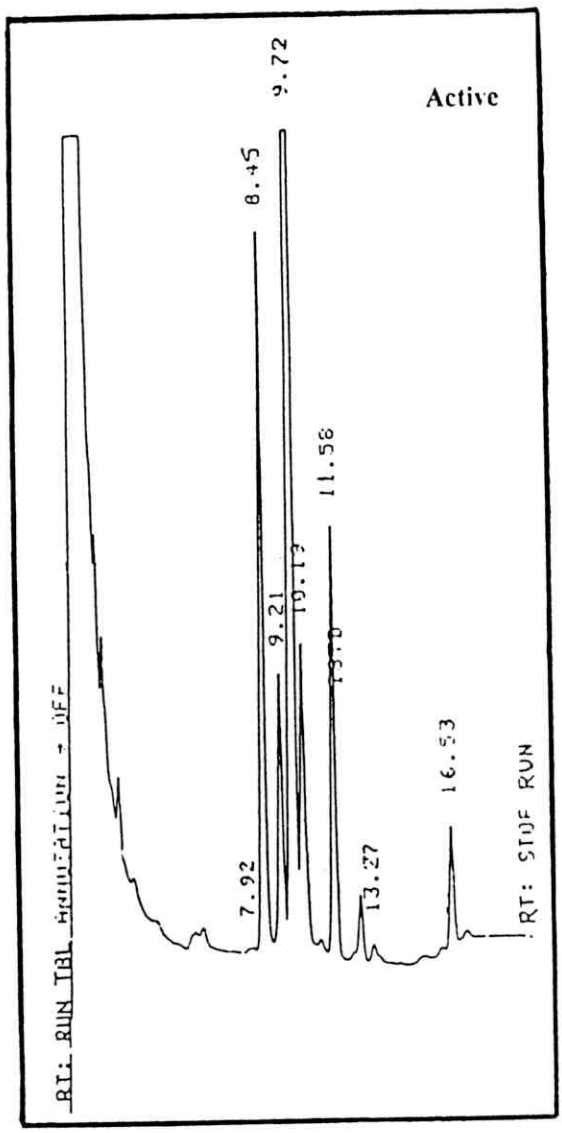
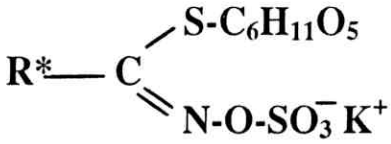


Fig. (8): GLC chromatogram of desulpho-glucosinolate derivatives in rapeseed of Active variety.



Glucosinolate (GS)

R: CH_2=CH-CH_2-CH_2-

3-butenyl-GS (Goitrin), (Gluconapin)

R: CH_2 CH-CH_2-CH_2-CH_2-

4-petenyl-GS-(Glucobrassicanapin)

R: CH_2=C=CH-

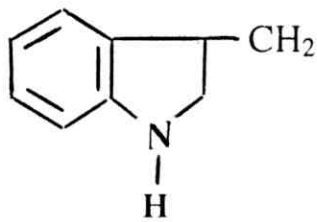
allyl-GS (Sinigrin)

R: 

***P*-OH-benzyl-GS (Sinalbin)**

R: CH_2=CH-CH(OH)-CH_2-

2-OH-3-butenyl-GS (Progoitrin)

R: 

4-OH-3-indolylmethyl-GS (Glucobrassicin)

R: CH_2=CH-CH_2-CH(OH)-CH_2-

2-OH-4-pentenyl-GS

Chart (1): Basic structure of different glucosinolate (GS) compounds in different rapeseed varieties proposed by Tapper and Gibbon (1967).

On the other hand, allyl- and ***P***-OH-benzyl-glucosinolates were detected in trace amounts in most of different rapeseed species under investigation. Furthermore, allyl-glucosinolates was not detected in Hanna while ***P***-OH-benzyl-glucosinolate was not detected in Weibub, Ro Meo T, Brutor 95C and Hanna. Such results are in accordance with the data obtained by **Underhill and Kirkland (1971).**

Robbelin and Thies (1980) mention that allyl-glucosinolate is found in trace amount in rapeseed, while ***P***-OH-benzyl-glucosinolate is not present in most of rapeseed varieties (***Brassica Napus***).

On the contrary, **Olsen and Sørensen (1980)** in their study on the analysis of glucosinolates proposed that sinalbin (***P***-OH-benzyl-glucosinolate) is one of the dominating compounds in seeds of *Brassica napus*. Also they concluded that the presence of relatively high concentrations of sinalbin and indolylmethyl-glucosinolates in seeds of rape is due to relation of glucosinolates catabolyzme.

3.1.4 Physicochemical Properties of Rapeseed Oil Varieties:

The samples under investigation were subjected to the routine analysis of oils and fats. The physicochemical properties of an oil or fat determine to some extent, its possible application in either industry or nutrition. Table (9) refers to the physicochemical properties of the samples which included the refractive index, specific gravity, acid value, iodine value, saponification value, peroxide value and unsaponifiable matter percent which could be briefly criticized in the following:

The refractive index serves as an indication of the degree of unsaturation. The presence of a high concentration of unsaturated fatty

Table (9) : Physicochemical properties of oil from different varieties of rapeseed.

No.	Varieties *Brassica napus*	Physical Properties		Chemical Properties				
		Refractive index at 25°C	Specific gravity at 25°C	Acid value	Iodine value	Saponification value	Peroxide value meq/kg	Unsaponifiable matter %
1	Hohenheimer	1.4613	0.9175	0.32	110.30	184.10	0.40	1.22
2	Weibub	1.4623	0.9122	0.25	111.20	186.09	0.39	1.06
3	Cloza	1.4617	0.9166	0.35	113.50	189.16	0.41	1.28
4	Ro Meo T	1.4619	0.9295	0.27	113.80	190.38	0.35	1.21
5	Brutor 95C	1.4635	0.9222	0.34	114.50	188.30	0.35	1.24
6	Orpal 95C	1.4640	0.9185	0.38	110.90	183.99	0.29	1.27
7	Altex	1.4641	0.9184	0.38	113.20	187.20	0.30	1.37
8	Regent	1.4620	0.9165	0.29	107.80	182.02	0.33	1.27
9	Tower	1.4623	0.9160	0.27	112.40	188.92	0.38	1.38
10	Niklas	1.4617	0.9183	0.31	114.20	188.62	0.27	1.26
11	Brutor	1.4630	0.9188	0.40	112.30	187.41	0.28	1.24
12	Cresor	1.4633	0.9175	0.35	112.30	187.97	0.39	1.37
13	Hanna	1.4640	0.9164	0.31	116.10	189.07	0.37	1.13
14	Active	1.4641	0.9129	0.34	114.10	188.93	0.33	1.32

acids and a great amount of long chain fatty acids in all varieties of rapeseed oils leads to an increase in its refractive index, as reported by **Parodi and Dunstan (1971).** The specific gravity of all samples were nearly identical with the reported values by **Farag *et al.* (1986).**

The acid values obtained in this work were small and this is understandable since the samples under investigation were quite fresh and well dried. Data in Table (9) showed that oil of Hanna variety was higher in its iodine value i.e. 116.1 than that of other varieties which ranged from 107.8 to 114.5. Such results were in agreement with the values obtained by **Kramer *et al.* (1983).**

The variation in the saponification values of the different extracted oils from rapeseed varieties are shown in Table (9), results showed that oil of Ro Meo T variety was higher in its saponification value i.e. 190.38 than that of other varieties which the value ranged from 182.02 (Regent) to 189.16 (Weibub). Such values were found to be in accordance with the results reported by **Kramer *et al.* (1983).**

Autoxidation in the extracted oils was estimated by peroxide value. Data presented in Table (9), showed that the peroxide value found in all samples were relatively very small. Such results clearly indicate that the effect of autoxidation was very little on the different isolated oils. The unsaponifiable matters percentage ranged from 1.06% (Weibub) to 1.38% (Tower variety), the obtained data were within the range reported by **Farag *et al.* (1986).**

3.1.5 Fatty Acids Composition of Rapeseed Oil Varieties:

The fatty acids composition of rapeseed oil for fourteen varieties were analysed by GLC.

The GLC of the methyl esters of rapeseed fatty acid showed that the total saturated fatty acids represented 6.3% (Orpal 95C) to 8.1% (Altex) while the unsaturated ones were 92.1% (Altex) to 94.2% (Regent) as shown in Table (10).

The predominant saturated fatty acid in all varieties was palmetic acid ($C_{16:0}$). Its amount ranged from 3.4% (Orpal 95C) to 5.6% (Altex). Similar values were reported by **Doweny (1964) and Farag *et al.* (1986).** Stearic acid ($C_{18:0}$) was found in amounts ranged from 1.3% (Hohenheimer) to 1.7% (Ro Meo T), while other saturated fatty acids, e.g. arachidic acid ($C_{20:0}$) and behenic acid ($C_{22:0}$) were found in lower amounts. On the other hand, myristic acid ($C_{14:0}$) was not detected in the oils under investigation. Such results are in agreement with those reported by **Kramer *et al.* (1983).**

The obtained results showed that the major constituents of unsaturated fatty acids in oils extracted from all rapeseed varieties were $C_{18:1}$, $C_{18:2}$ and $C_{18:3}$. It is clear that oleic acid ($C_{18:1}$) was the most prevalent unsaturated fatty acid ranged from 36.3% (Regent) to 60.3% (Ro Meo T). Linoleic acid ($C_{18:2}$) was the second major unsaturated acids, its content ranged from 16.0% (Brutor) to 21.2% (Hanna). Linolenic acid ($C_{18:3}$) was the third major unsaturated fatty acids, its content ranged from 7.8% (Brutor) to 10.5% (Hanna).

Table (10) : Fatty acids composition of different rapeseed oil varieties.
Fatty acids composition %.

No.	Varieties *Brassica napus*	Fatty acids composition %									TU/TS*
		$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:0}$	$C_{20:1}$	$C_{22:0}$	$C_{22:1}$	
1	Hohenheimer	4.18	1.30	47.10	17.20	8.90	0.60	8.70	0.40	11.60	13.0:1
2	Weibub	4.10	1.60	46.70	18.10	9.80	0.60	9.80	0.30	9.10	14.2:1
3	Cloza	4.30	1.69	56.30	18.60	10.40	0.60	4.80	0.30	2.90	13.3:1
4	Ro Meo T	4.50	1.70	60.30	19.20	10.30	0.60	1.90	0.60	0.80	12.5:1
5	Brutor 95C	4.70	1.50	59.70	18.20	8.20	0.50	3.30	0.30	3.50	13.3:1
6	Orpal 95C	3.40	1.60	43.95	16.83	9.71	0.61	8.17	0.46	15.13	15.5:1
7	Altex	5.60	1.50	52.60	19.50	9.20	0.50	5.70	0.40	5.10	11.4:1
8	Regent	4.40	1.40	36.30	18.80	10.20	0.50	11.75	0.40	16.20	14.1:1
9	Tower	4.07	1.60	57.40	18.00	10.00	0.60	4.40	0.30	3.60	14.4:1
10	Niklas	4.30	1.50	53.90	19.90	10.23	0.50	4.70	0.40	4.50	13.9:1
11	Brutor	5.10	1.60	59.46	16.00	7.80	0.50	4.10	0.30	5.20	12.4:1
12	Cresor	4.00	1.60	53.60	18.00	10.00	0.60	6.30	0.50	5.20	13.9:1
13	Hanna	4.10	1.50	54.00	21.20	10.50	0.60	4.47	0.40	3.30	14.2:1
14	Active	4.30	1.60	54.90	19.80	10.34	0.50	4.60	0.50	3.40	13.5:1

* Total unsaturated : total saturated.

Concerning the gadoleic acid ($C_{20:1}$) and erucic acid ($C_{22:1}$) content, the obtained data showed that Weibub, Hohenheimer, Orpal 95C and Regent varieties contains a highest amount of gadoleic and erucic acids (9.8% and 9.1%), (8.7% and 11.6%), (11.7% and 14.0%) and (11.75% and 16.2%) respectively. While Ro Meo T variety oil yielded a little amount of gadoleic and erucic acids (1.9% and 0.8% respectively). The obtained data showed that the amounts of these fatty acids in the other varieties oils were almost similar (3.3% to 6.3% and 2.9% to 5.2% respectively).

The obtained data shown in Table (10) revealed that the ratios between total unsaturated to total saturated acids (TU/TS) ranged from 11.4:1 (Altex) to 15.5:1 (Orpal 95C). The latter value simply means that the unsaturated acids are more than 11 folds that of the saturated ones. Such values were higher than that recommended for the common edible oils e.g. cottonseed, sunflower, peanut and soybean oil which showed in general low ratios of (TU/TS) i.e. 2.4:1.0, 7.8:1.0, 3.2:1.0 and 2.4:1.0 respectively. This means that the proportion of different unsaturated acids are mostly dependent upon its natural source and rapeseed oil might be considered imbalanced edible oil.

It is quite clear from the previous data that rapeseed oils of different varieties under investigation contained appreciable quantities of fatty acids with chain lengths greater than the usual eighteen carbon atoms, and significant amounts of polyunsaturated acids are also present. A clear linear relationship between oleic, gadoleic and erucic acids might be originated in the seed oils of all varieties. In the other words, a high oleic acid content in Cloza, Brutor and Ro Meo T varieties i.e. 56.3%,

59.46% and 60.3% was accompanied by a low gadoleic acid and erucic acid amounted from 1.9% to 4.8% and 0.8% to 5.2% respectively. While Hohenheimer, Orpal 95C and Regent varieties of high erucic acid strain. Its contents ranged from 11.6% to 16.2% of erucic acid ($C_{22:1}$) accompanied with a high gadoleic acid ($C_{20:1}$) reached to 11.75% and low level of oleic acid ($C_{18:1}$) reached to 36.3% (Regent). Obviously, the elongation of oleic acid to erucic acid was the main pathway of biosynthesis of the latter acid. This deduction agreed with that reported by **Jönsson (1977)** who suggested that the addition of two carbon atoms to the carboxyl group of oleic acid form eicosenoic acid, followed by second addition of another two carbon to form erucic acid.

Kirk and Oram (1981), stated that breeding of new strains of low erucic acid from different varieties i.e. ***B.napus***, ***B.compestris*** and ***B.juncea***, had led to an increase in oleic acid content. The embryo's genetic ability for carbon chain elongation of the fatty acids has been blocked, and no more carbon could be added resulting in an accumulation of the precursor, oleic acid. Such conclusion interpreted why oleic acid increases in low erucic rapeseed strains on the account of erucic formation.

Rapeseed oils contain a low percentage of linoleic acids ($C_{18:2}$) which ranged from 16.0% (Brutor) to 21.2% (Hanna). The latter amounts greatly increased in the common edible oils e.g. cottonseed, sunflower, peanut and soybean oil which ranged from 41.8% in soybean oil to 71.5% in sunflower oil. The previous results are in good agreement with **Farag *et al.* (1986).**

3.1.6 Fractionation and Identification of Unsaponifiable Matter Components of Rapeseed Oil Varieties:

Unsaponibiable matter of fourteen varieties oils were separated by using TLC technique and analyzed by using capillary column gas liquid chromatography. The relative percentages of both hydrocarbon and sterol components are shown in Tables (11 and 12).

It is obvious from the obtained results in Tables (11 and 12) that the relative percentages of hydrocarbon and sterol components of rapeseed oils under investigation were quite different according to each variety oil. The total amount of hydrocarbon were found to be higher in Cresor 84.11%, Brutor 95C 82.14% and Brutor oils 81.62% compared with other investigated oil which ranged from 64.30% (Tower) to 76.28% (Regent).

From the same result recorded in Tables (11 and 12), it could be observed that total sterols showed a reveres trend than those obtained for total hydrocarbons of the unsaponifiable matter as for Cresor oil which had the lowest percentage of hydrocarbons (64.30%), it showed the highest percentage of sterol content (35.70%).

The percentages of hydrocarbon and sterol in the unsaponifiable matter of rapeseed were in the range (63.08% to 97.04%) and (0.54% to 36.92%) respectively as stated by **Farag *et al.* (1986), Mohamed et al. (1987) and Shabana *et al.* (1989).**

From the data shown in Table (11) it could be observed that, the hydrocarbon fractions of all rapeseed oils could be divided into three groups, first the predominant hydrocarbon fractions (>54%) which contain C_{25} as its percentage ranged from 54.37% (Altex) to

Table (11) : Hydrocarbon composition of the nonpolar fractions of the unsaponifiable matters of different rapeseed varieties.

No.	Varieties *Brassica napus*	%Hydro. / Unsap.*	% Hydrocarbon / Total hydrocarbons															
			C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	Un-known	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{27}	C_{28}	UC_{30}	C_{30}	C_{32}
1	Hohenheimer	66.96	—	1.02	1.03	0.70	2.87	1.89	1.88	2.43	1.86	4.58	67.26	5.68	1.33	1.25	4.37	0.81	1.15
2	Weibub	79.13	—	1.00	0.90	0.52	2.33	1.20	2.02	2.18	2.55	11.02	58.54	6.94	2.35	2.96	3.48	0.55	1.67
3	Cloza	81.09	0.27	1.42	0.60	0.80	2.15	1.60	1.19	1.15	1.41	5.74	68.32	3.75	0.66	3.64	3.58	0.66	3.33
4	Ro Meo T	80.05	0.05	0.80	0.54	0.70	2.39	0.97	1.00	0.88	1.53	4.17	76.77	4.91	0.67	1.11	0.38	0.23	3.12
5	Brutor 95C	82.14	2.04	2.14	3.18	0.60	3.90	1.90	1.53	1.45	0.29	3.30	67.72	3.32	1.22	2.12	1.98	0.64	2.34
6	Orpal 95C	81.23	2.35	2.78	3.53	0.91	4.03	0.98	1.38	1.40	0.82	4.04	64.09	4.61	2.46	1.62	1.79	0.77	2.37
7	Altex	68.69	2.57	2.81	3.21	0.82	3.48	1.68	0.60	1.86	1.82	5.94	54.37	4.41	4.58	2.25	4.98	0.92	3.78
8	Regent	71.28	2.29	1.83	3.38	0.91	4.28	0.72	1.47	0.43	0.48	4.13	67.69	4.81	1.72	1.22	1.88	0.31	2.17
9	Tower	64.30	0.29	2.36	1.30	0.75	2.68	0.42	1.00	0.25	1.14	5.49	74.02	4.33	0.70	1.52	1.30	0.35	2.24
10	Niklas	69.75	1.10	1.20	2.81	0.60	2.52	0.31	1.61	0.72	0.90	3.51	73.64	3.80	2.24	1.74	1.31	0.40	1.74
11	Brutor	81.62	0.70	1.37	2.60	0.50	2.55	1.53	1.57	1.80	1.20	3.30	70.19	5.90	1.99	1.54	2.03	0.11	1.21
12	Cresor	84.11	0.37	1.58	2.96	0.45	2.86	3.13	2.38	2.04	0.83	4.29	64.00	5.21	4.34	2.68	1.42	0.17	1.31
13	Hanna	81.05	0.48	2.34	2.79	0.56	2.40	2.57	1.44	2.08	1.50	3.35	68.70	3.52	3.33	1.21	2.02	0.44	1.50
14	Active	80.73	1.55	1.08	2.99	0.67	2.54	1.39	1.35	1.72	1.60	3.44	67.22	5.77	2.94	1.74	2.81	0.29	1.35

*Hydrocarbon / Unsaponifiable matter

Table (12): Sterols composition of polar fractions of different rapeseed varieties.

No.	Varieties *Brassica napus*	% Sterol / Unsaponifiable	% Sterols / Total sterols			
			Brassicasterol	Campesterol	Stigmasterol	β-sitosterol
1	Hohenheimer	34.04	10.84	24.95	4.22	59.99
2	Weibub	20.87	12.94	22.29	4.17	60.59
3	Cloza	18.91	13.74	23.33	6.27	56.66
4	Ro Meo T	19.90	12.38	22.74	6.37	58.51
5	Brutor 95C	17.86	15.19	21.84	5.52	57.13
6	Orpal 95C	18.77	14.42	20.37	4.48	60.80
7	Altex	31.31	21.67	18.13	7.93	52.31
8	Regent	28.72	12.97	26.86	6.44	52.83
9	Tower	35.70	11.45	23.39	5.20	60.10
10	Niklas	30.25	13.28	20.36	4.89	61.48
11	Brutor	18.38	15.34	22.20	3.21	59.23
12	Cresor	15.89	14.95	21.18	5.34	58.52
13	Hanna	18.95	16.50	17.90	7.33	58.08
14	Active	19.27	10.55	23.32	6.71	58.72

76.77% (Brutor). The second group, represents moderate component (>3%) comprised C_{24} and C_{26}, their percentages ranged from 3.3% (Brutor) to 5.94% (Altex) and 3.32% (Brutor 95C) to 6.94% (Weibub) respectively. The third group represents minor component (<3%), included C_{16}, C_{17}, C_{18}, C_{19}, C_{20}, C_{21}, C_{22}, C_{23}, C_{27}, C_{28}, C_{30} and C_{32}.

These results are disagreement with **Rady *et al.* (1990)** who reported that C_{23} is the predominant hydrocarbon of LEAR oil which ranged between (26.9% to 47.7%) followed by C_{21} ranged between (22.7% to 52.3%), C_{22} ranged between (0.0% to 19%) and C_{28} ranged between (0.0% to 10.6%). But **El-Sayed (1987)** found that, the predominant hydrocarbon of LEAR oil were C_{22} (37.4%), C_{23} (28.3%), C_{28} (25%) and C_{27} (9.3%). Moreover, **Farag *et al.* (1986)** reported that, the predominant hydrocarbon in LEAR was C_{24} ranged between (4.62% to 74.5%) and other hydrocarbons were not represented more than 5% of total hydrocarbons. Also, **Mohamed *et al.* (1987)** reported that, the major hydrocarbon in LEAR oil was C_{28} followed by C_{20}, C_{22} and C_{19}. The other hydrocarbons were not represented more than 5%.

The data in Table (12) indicated that the β-sitosterol is the major sterol component of all rapeseed varieties oils which ranged from 52.31% (Altex) to 61.48% (Colza). These findings are in harmony with those of **Itoh *et al.* (1973), Farag *et al.* (1986) and Rady *et al.* (1990).** In addition, it could be observed that the brassicasterol and campesterol were represented 10.55% (Active) to 21.67% (Altex) and 17.90% (Hanna) to 26.86% (Regent) of total sterols of oil respectively. These result are

harmonized with those obtained by **Appelqvist *et al.* (1981) and Rady *et al.* (1990).**

The same data Table (12) also indicated that the stigmasterol represented 3.21% (Brutor) to 7.93% (Altex). This finding agree with **Farag *et al.* (1986).**

3.2 Oil Blends:

3.2.1 Physicochemical properties of some edible oils & blends:

Tables (13, 13a, 13b and 13c) refer to the major physicochemical properties of palm oil, refined bleached deodorized palm olein RBD, double fractionated palm olein DF, rapeseed, sunflower and blends of those oils, which considered as a good criterion for quality and nutritive value of these edible oils.

The specific gravity of fixed oils and fats is always less than 1.00. The specific gravity of the samples under investigation were determined at 25°C as reported in Tables (13, 13a, 13b and 13c). The specific gravity of both palm oil and unsaturated oils (rapeseed and sunflower oils) were nearly identical with the reported values by **Khalaf (1992), Shabana *et al.* (1990) and Abd EL-Rahman (1991)**. Refractive index serves as an indication of the degree of unsaturation. The presence of a high concentration of unsaturated fatty acids and a great amount of long chain fatty acids in rapeseed and sunflower oils leads to an increase in its refractive index as reported by **Allen (1978).**

Table (13): Physicochemical properties of some edible oils.

Oil	Physical Properties			Chemical Properties									
	Refractive Index at 40°C	Specific Gravity at 40°C	Melting point °C	Acid Value	Iodine Value	Saponification Value	Peroxide Value	TBA		Benzidine No.	Dienes %	Unsaponifiable Matter %	Stability (hrs.) at 100°C
								530nm	450nm				
Palm oil	1.4667	0.9161	40	2.19	48.67	193.45	0.23	0.005	0.05	3.49	0.09	0.54	44.20
Palm olein RBD*	1.4554	0.9088	21.5	1.66	55.92	192.90	0.32	0.038	0.005	2.13	0.22	0.56	42.90
Palm olein DF**	1.4516	0.9144	14.0	0.60	57.43	194.50	0.17	0.005	0.000	5.43	0.13	0.54	21.80
Palm stearin	1.4605	0.9088	49.3	0.43	49.95	199.50	0.14	0.000	0.000	2.01	0.03	0.50	-----
Rape	1.4656	0.9165	-27	3.51	102.03	176.18	3.63	0.000	0.000	8.61	0.14	0.80	14.80
Sunflower	1.4676	0.9192	-22	0.32	116.93	193.50	3.89	0.035	0.045	5.76	0.40	0.82	6.20

*RBD = Refined bleached deodorized
**DF = Double fractionated

Table (13a): Physicochemical properties of oil blends.

Oil blends	Physical Properties			Chemical Properties									
	Refractive Index at 40°C	Specific Gravity at 40°C	Melting point °C	Acid Value	Iodine Value	Saponification Value	Peroxide Value	TBA		Benzidine No.	Dienes %	Unsaponifiable Matter %	Stability (hrs.) at 100°C
								530nm	450nm				
Rape : Palm olein BRD													
9 : 1	1.4614	0.9143	-14	3.37	97.30	177.04	7.10	0.020	0.005	2.85	0.14	0.76	15.60
8 : 2	1.4614	0.9135	-11	3.19	93.39	178.64	4.26	0.020	0.009	3.45	0.14	0.75	15.20
7 : 3	1.4605	0.9127	-11	1.95	88.61	180.94	4.16	0.026	0.010	3.84	0.15	0.73	16.70
6 : 4	1.4606	0.9157	-8	2.54	83.30	182.74	3.85	0.028	0.004	4.26	0.13	0.71	17.90
5 : 5	1.4606	0.9150	-5	2.33	79.43	184.97	2.73	0.034	0.005	4.89	0.15	0.67	20.00
Rape : Palm olein DF													
9 : 1	1.4675	0.9159	-23	3.44	96.54	178.20	4.23	0.020	0..004	4.15	0.13	0.77	14.90
8 : 2	1.4665	0.9158	-19	2.87	94.83	179.98	3.04	0.020	0.007	3.74	0.10	0.73	16.20
7 : 3	1.4665	0.9155	-10	2.97	88.67	181.74	1.07	0.025	0.008	3.84	0.10	0.72	17.00
6 : 4	1.4655	0.9163	-5	4.30	84.61	183.65	1.07	0.025	0.005	4.15	0.14	0.70	18.20
5 : 5	1.4645	0.9171	-2	2.13	79.70	184.40	2.38	0.028	0.050	3.81	0.13	0.68	20.30
Rape : Sunflower													
9 : 1	1.4635	0.9173	-26	4.85	104.89	177.90	8.60	0.007	0.005	2.95	0.18	0.80	12.10
8 : 2	1.4625	0.9176	-26	4.76	105.28	17958	10.01	0.009	0.005	3.27	0.24	0.80	10.20
7 : 3	1.4635	0.9179	-24	2.77	106.42	181.51	12.19	0.016	0.009	3.55	0.24	0.81	9.37
6 : 4	1.4635	0.9168	-24	3.47	107.45	183.79	12.54	0.023	0.010	3.87	0.34	0.81	8.47
5 : 5	1.4635	0.9170	-24	5.61	109.49	184.85	15.12	0.031	0.012	4.26	0.42	0.81	7.32

Table (13b): Physicochemical properties of oil blends.

Oil blends	Physical Properties			Chemical Properties									
	Refractive Index at 40°C	Specific Gravity at 40°C	Melting point °C	Acid Value	Iodine Value	Saponification Value	Peroxide Value	TBA		Benzidine No.	Dienes %	Unsaponifiable Matter %	Stability (hrs.) at 100°C
								530nm	450nm				
Sunflower : Palm olein BRD													
9 : 1	1.4606	0.9182	-19	2.07	110.10	193.59	18.41	0.041	0.020	5.66	0.49	0.79	7.58
8 : 2	1.4615	0.9171	-18	2.20	103.99	193.45	10.49	0.038	0.030	5.68	0.36	0.77	8.20
7 : 3	1.4605	0.9160	-14	1.80	99.08	192.98	8.51	0.040	0.032	5.77	0.38	0.74	8.17
6 : 4	1.4595	0.9140	-10	0.17	92.85	193.62	5.70	0.024	0.020	5.83	0.25	0.72	9.78
5 : 5	1.4595	0.9140	-7	0.10	85.93	193.00	7.10	0.032	0.022	5.67	0.33	0.69	9.47
Sunflower : Palm olein DF													
9 : 1	1.4695	0.9187	-18	1.21	111.74	193.15	5.06	0.032	0.006	6.48	0.30	0.80	9.12
8 : 2	1.4685	0.9182	-15	2.10	105.36	193.25	4.30	0.030	0.005	6.52	0.21	0.76	10.20
7 : 3	1.4675	0.9178	-12	1.42	99.85	193.73	2.53	0.025	0.005	6.11	0.23	0.74	11.30
6 : 4	1.4665	0.9174	-9	1.85	93.93	193.90	3.30	0.028	0.016	6.35	0.21	0.71	12.50
5 : 5	1.4657	0.9168	-6	1.51	87.41	194.64	4.11	0.028	0.023	6.47	0.16	0.63	14.20
Sunflower : Rape													
9 : 1	1.4625	0.9189	-22	2.17	115.05	191.45	19.87	0.034	0.007	5.10	0.60	0.82	6.08
8 : 2	1.4635	0.9187	-23	2.23	113.01	190.75	18.94	0.030	0.005	4.79	0.59	0.82	6.25
7 : 3	1.4625	0.9184	-23	3.68	111.50	188.02	16.61	0.028	0.006	4.55	0.53	0.81	6.58
6 : 4	1.4625	0.9181	-24	3.03	110.65	186.85	16.24	0.030	0.016	4.44	0.44	0.81	6.92
5 : 5	1.4625	0.9179	-24	5.61	109.49	184.85	15.21	0.030	0.013	4.20	0.43	0.81	7.35

Table (13c): Physicochemical properties of oil blends.

Oil blends	Physical Properties			Chemical Properties									
	Refractive Index at 40°C	Specific Gravity at 40°C	Melting point °C	Acid Value	Iodine Value	Saponification Value	Peroxide Value	TBA		Benzidine No.	Dienes %	Unsaponifiable Matter %	Stability (hrs.) at 100°C
								530nm	450nm				
Rape:Sun: Palm olein BRD													
1 : 1 : 1	1.4605	0.9115	-12	2.49	91.54	187.84	4.55	0.030	0.040	4.72	0.22	0.74	11.40
2 : 1 : 1	1.4606	0.9153	-14	5.51	91.98	184.34	5.73	0.031	0.060	4.16	0.16	0.75	12.20
1 : 2 : 1	1.4615	0.9159	-12	4.67	97.79	189.67	8.78	0.030	0.070	4.57	0.22	0.76	9.33
1 : 1 : 2	1.4614	0.9133	-5	5.94	82.93	188.87	2.91	0.028	0.050	5.13	0.17	0.69	14.60
Rape:Sun: Palm olein DF													
1 : 1 : 1	1.4606	0.9165	-8	3.23	92.25	187.97	2.93	0.030	0.038	5.18	0.18	0.73	12.80
2 : 1 : 1	1.4605	0.9144	-15	2.61	94.74	184.99	3.78	0.030	0.062	4.73	0.15	0.74	12.70
1 : 2 : 1	1.4615	0.9173	-10	4.86	97.67	188.93	1.94	0.029	0.067	6.05	0.20	0.75	10.90
1 : 1 : 2	1.4605	0.9161	-7	3.60	84.47	189.41	1.30	0.028	0.051	3.63	0.17	0.68	15.50

The presence of a high concentration of saturated fatty acid in palm oil and its fractions, palm olein RBD and DF leads to an increase in its melting point, 40°C, 21.5°C and 14.0°C respectively. While rapeseed and sunflower oil had the lowest melting point -27°C and -22°C respectively. Blends of rapeseed or sunflower oils with palm oil fractions palm olein RBD or DF leads to an improve of its melting point.

Acid value is usually considered to be one of the main parameters for evaluating the quality of an oil. The determination of acid value measures the content of free fatty acids which results partly from hydrolysis and partly from further oxidation of the secondary products which formed in the oil.

Data presented in Table (13) shows that sunflower oil had the highest iodine value 116.93 compared to other oils. This high iodine value could be attributed to the large amount of linoleic acid found in sunflower oil. The obtained value of sunflower oil is in the line with those obtained by **American Fat and Oil Association (1988)**. Meanwhile, iodine value for rapeseed oil was 102.03. On the other hand palm oil, palm olein RBD and palm olein DF had the lowest iodine values 48.67, 55.92 and 57.43, respectively compare to other oils. Such results indicate the presence of a high concentration of saturated fatty acids in palm oil and its fractions palm olein RBD and DF leads to a decrease in its iodine value.

Iodine value of blending rapeseed or sunflower oils with palm olein RBD or palm olein DF were decreased. Such value decreased from 97.30 at the ratio (9:1 of rape : palm olein RBD) to 79.43 at the ratio (5:5) of the same blending. While iodine value was decreased from 111.74 to 87.41 of

blending (sunflower:palm olein DF) at the ratios (9:1) and (5:5) respectively.

Saponification value is a measure of the average chain length or mean molecular weight for normal fatty acid esters, palm oil, palm olein RBD, palm olein DF and sunflower oil had similar saponification vlaue (192.90-194.50). In addition, the obtained saponification value of rapeseed oil is in agreement with the range reported by **El-Sayed (1987)**, while this value disagreed with those reported by **Farag *et al.* (1986) and Rady *et al.* (1990).** This variation in the saponification value of rapeseed oil may be due to the variety of rapeseed. Blending rapeseed oil with palm olein RBD or palm olein DF caused saponification value increased, it increased from 178.2 in the (9:1, rape : palm olein DF) to 184.40 in the (5:5, rape : palm olein DF), while saponification value decreased from 191.45 in (9:1, sunflower : rape) to 184.85 in (5:5, sunflower : rape).

The peroxide vlaue of different vegetable oils obtained during experimental work were determined according to **A.O.C.S. (1982)**. The results obtained for pure and blends oils, Tables (13, 13a, 13b and 13c) indicate that the samples obtained in the course of this investigation had very low peroxide values ranging from (0.17 to 3.89). Such results simply show that very little oxidation had occurred in the pure oils. However in blends oil, a blend of rapeseed oil with sunflower oil had the highest peroxide values ranges from (8.6 to 19.87).

Estimation of the conjugated fatty acids in an oil is one of the criteria used to detect the oxidative rancidity of this oil. The conjugated diene fatty acids of all oils under investigation and their blends from 0.09% to

0.60%. Such results may be simply show that very little oxidation had occurred in the pure oils and their blends

Oxidation of polyunsaturated fatty acids is accompanied by increased ultraviolet absorption. Fatty acids with conjugated unsaturation absorb strongly in the regions 230 to 375nm, diene unsaturation at 234nm, and triene unsaturation at 268nm. The magnitude of change is not readily related to the degree of oxidation because the effects upon the various unsaturated fatty acids vary in quality and magnitude. However, the changes in the ultraviolet spectrum of a given substance can be used as a relative measurement of oxidation.

Oils containing linoleate or more highly unsaturated fatty acids are oxidized to conjugated diene systems that can be measured by ultraviolet absorption at 234nm, **Gray (1978)**.

From the obtained data, Table (13), rapeseed and sunflower oils showed the highest value in the thiobarbituric number (TBA) at the two different absorbance (0.036, 0.048) for the former and (0.035, 0.045) for the latter. Such results indicate that the highest amounts of volatile compounds as aldehydes occurring in the polyunsaturated oils after different technological processes was accomplished. These results are similar to those reported for the benzidine number.

The unsaponfiable matter includes hydrocarbons, sterols, vitamins and pigments compounds usually play an important role in the oil stability. It is obvious from the same Tables (13, 13a, 13b and 13c) that, the oils under investigation had almost the same content of unsaponifiable matter (0.54% to 0.82%). These finding concerning unsaponifiable matter

percentage are closely agreed with those reported by **Gunstone *et al.* (1986).**

3.2.2 The stability of some edible oils and blends:

The induction period is an expression of the stability of oils and fats towards oxidation. The length of the induction period varies with the kind and the amount of unsaturation, the temperature, and the extent of contamination of antioxidants present.

Among all the common vegetable oils under study, the obtained data are shown in Fig. (9) indicated that palm oil, palm olein RBD and palm olein DF have the longest induction periods i.e. 44.2, 42.9 and 21.8 hrs at 100°C respectively. While rapeseed oil gave a relatively moderate induction period i.e. 14.80 hrs at 100°C and melts at -27°C.

Sunflower oil showed the lowest induction period i.e. 6.2 hrs at 100°C. Such oil melts at -22°C. These results are in good agreement with the data obtained by **Teah (1993).**

From the previous results, it has been noticed that the longest induction period of palm oil and its products comparing with that obtained from other vegetable oils owing to their inherent composition and to the presence of tocopherols which are natural antioxidants. In addition the ratios between unsaturated:saturated fatty acids composition are (1:1) as mentioned by **Teah (1993)**.

It is also noticed that the induction period of rapeseed oil are approximately 2.5 folds than that of sunflower oil, although the ratios between unsaturated : saturated for rapeseed is greater than that of

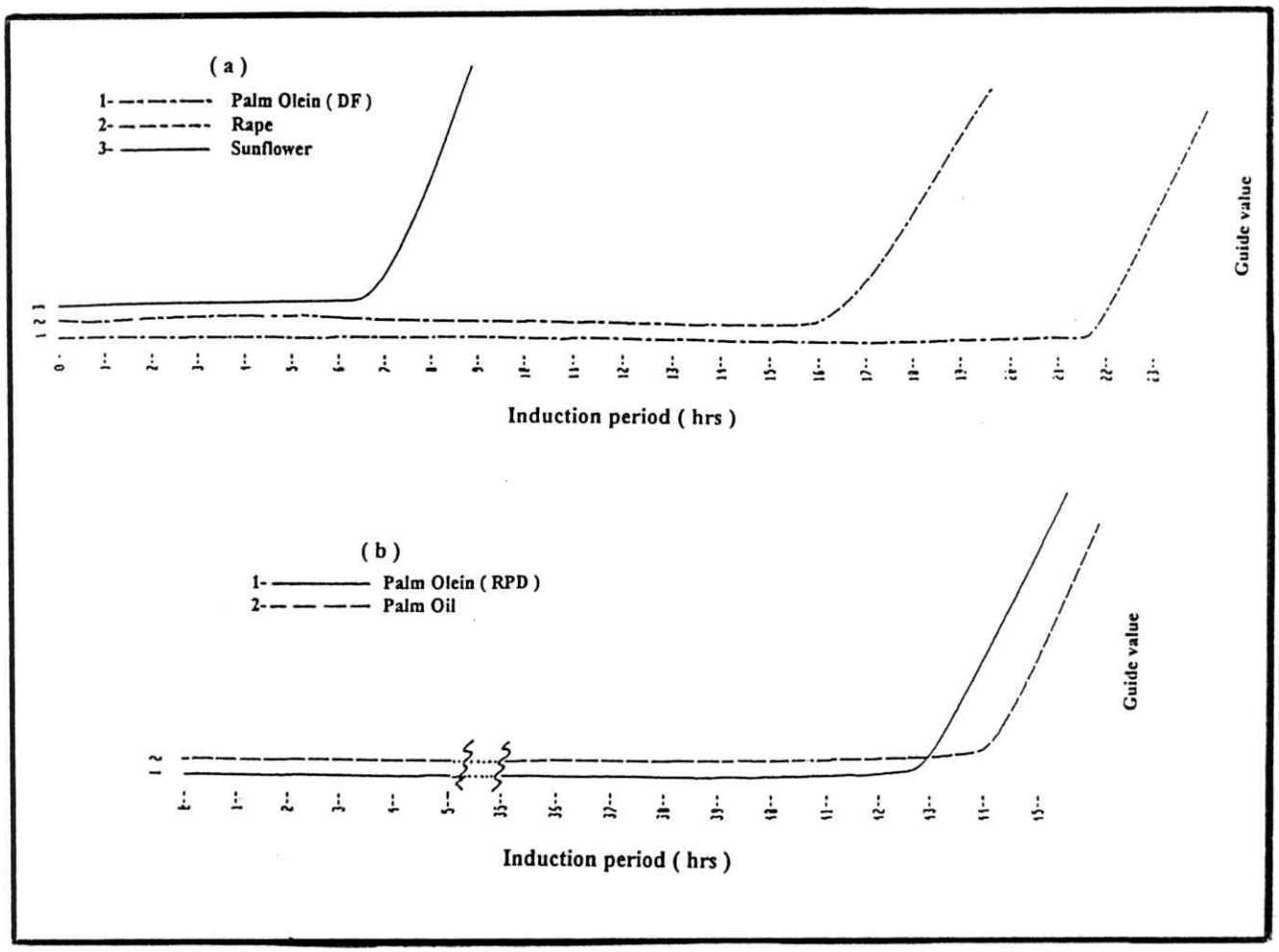


Fig. (9): Stability of pure oils of :(a) Palm olein (DF), Rape and Sunflower oils and (b) Palm olein (RBD) and Palm oil .

sunflower i.e. (15.55:1) for the former while such ratios amounted (8.66:1) for the latter. This phenomena attributed to the sunflower oil which concerning significant high levels of unsaturated fatty acid especially lenoleic acid ($C_{18:2}$) i.e. 65.12%. Such acid led to a reduction of induction period. **Lin (1991)** reported that the rate of oxidation of C_{18} are approximately 1:10:100:200 for $C_{18:0}$, $C_{18:1}$, $C_{18:2}$ and $C_{18:3}$ fatty acids respectively.

Rapeseed oil or sunflower oil were blended with palm olein RBD or palm olein DF in different ratios and the results are shown in Tables (13a and 13b) and Figs (10 and 11).

A blend of sunflower oil with palm olein DF resulted in a noticeable increase in the induction period especially in the ratios of 7:3 and 5:5. The induction period of sunflower 6.2 hrs increased to 11.3 and to 14.2hrs and melts at -12°C and -10°C respectively.

It has to be mentioned that the blending of sunflower oil with palm olein DF gave a considerable incerase in induction period than that obtained from blending sunflower oil with palm olein RBD.

The results are accordance with that reported by **Teah and Ibrahim (1991)**. The authors stated that, blends prepared with double-fractionated palm olein (DF) showed a better stability than those with single-fractionated oleins. They added that a blend of double fractionated olein (30%) with sunflower oil, or a similar oil, would be suitable for temperate countries.

It could be deduced from the obtainable data that a blending of rapeseed oil with palm olein RBD or palm olein DF caused a relatively

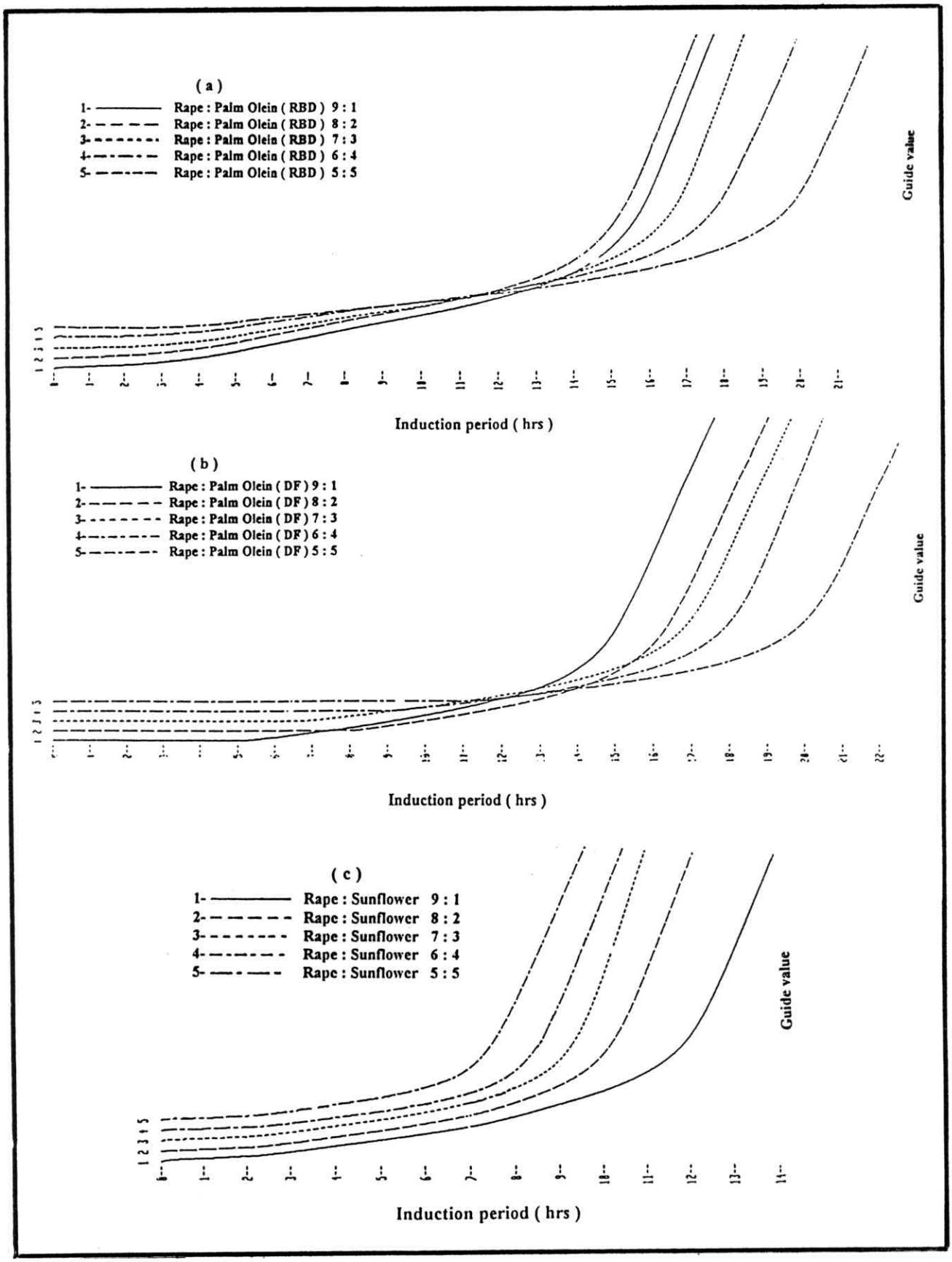


Fig. (10): Stability of blending Rapeseed oil with : (a) Palm olein (RBD), (b)Palm olein (DF) and (c) Sunflower oil .

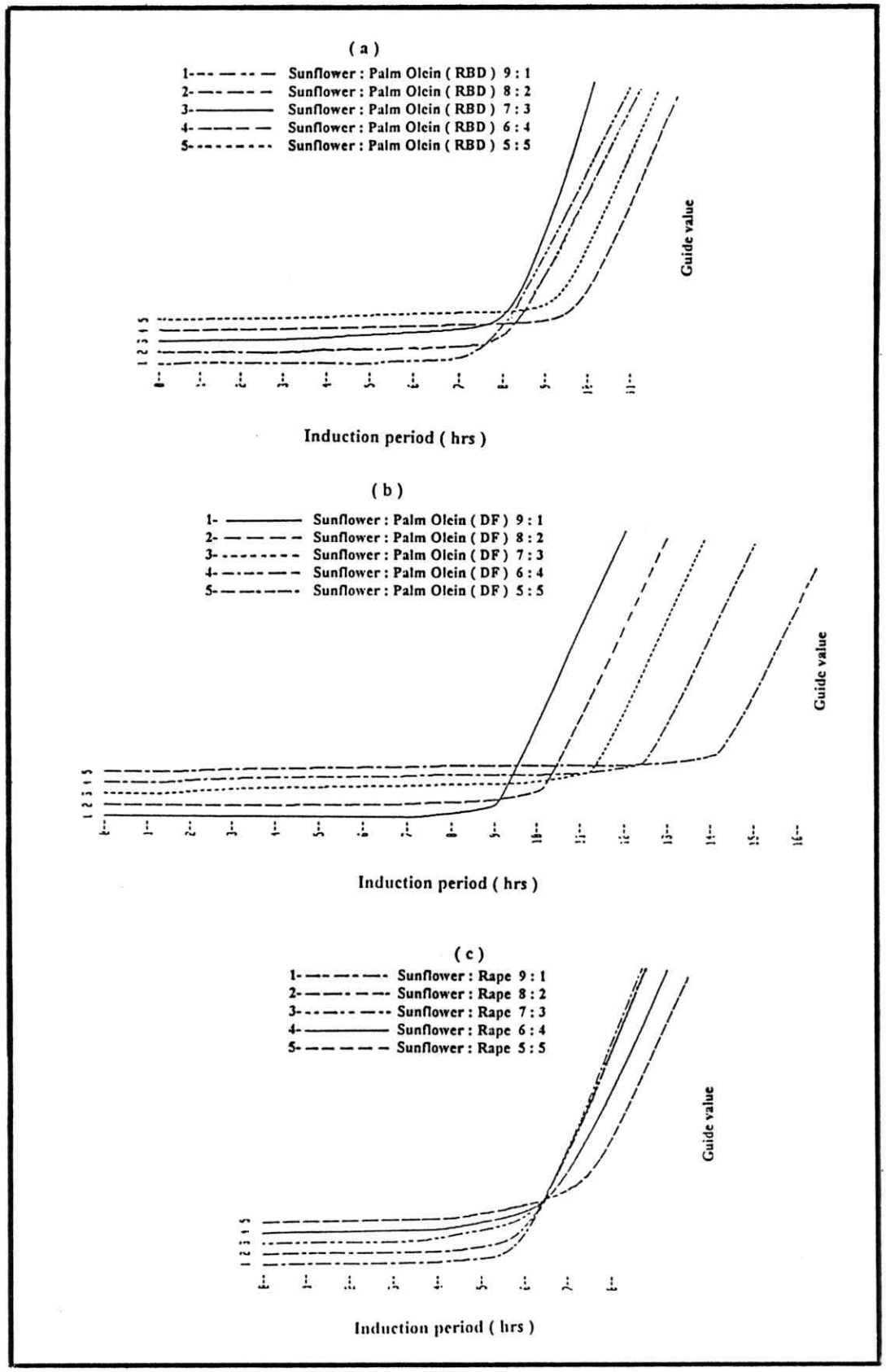


Fig. (11): Stability of blending Sunflower oil with : (a) Palm olein (RBD), (b) Palm olein (DF) and (c) Rapeseed oil .

lowest increase in the induction period comparing with a blending of sunflower oil with palm olein RBD or palm olein DF. Blending of sunflower oil with rapeseed oil caused the decrease in induction period. Such value decreases from 12.1 hrs in rape:sunflower (9:1) to 7:32 hrs at the ratio (5:5).

Data in Table (13c) and Fig (12) indicated that blending of rapeseed oil with both sunflower oil and palm olein RBD or palm olein DF in the ratios of (1:1:2) produced a noticeable increase in the induction period.

3.2.3 Fatty acid compositions of some edible oils and blends:

The fatty acid compositions of edible oils plays an important role in shelf life, nutrition and health. In this case, the frying fat is heated and reheated over an extended period of time. Quality changes occur such as oxidation, which my render the fat unsuitable for further use. The oxidation effect is particularly marked when highly unsaturated oils are used and soon results in polymerization and unsatisfactory flavours **(Second Arab Conference, 1993).**

The obtained results in Table (14) showed that the major constituents of unsaturated fatty acid in palm oil were $C_{18:1}$, $C_{18:2}$ and $C_{18:3}$. It is clear that oleic acid ($C_{18:1}$) was the most prevalent unsaturated fatty acid i.e. 41.53%. Linoleic acid ($C_{18:2}$) was the second major fatty acid i.e. 11.06%, while saturated fatty acids include 43.08% palmitic acid ($C_{16:0}$) and 3.03% stearic acid ($C_{18:0}$).

Table (14) showed that oleic and palmitic acids are the predominant fatty acids in palm olein RBD and palm olein DF i.e. (40.40% and 37.83%) for the former and (44.13% and 37.13%) for the later.

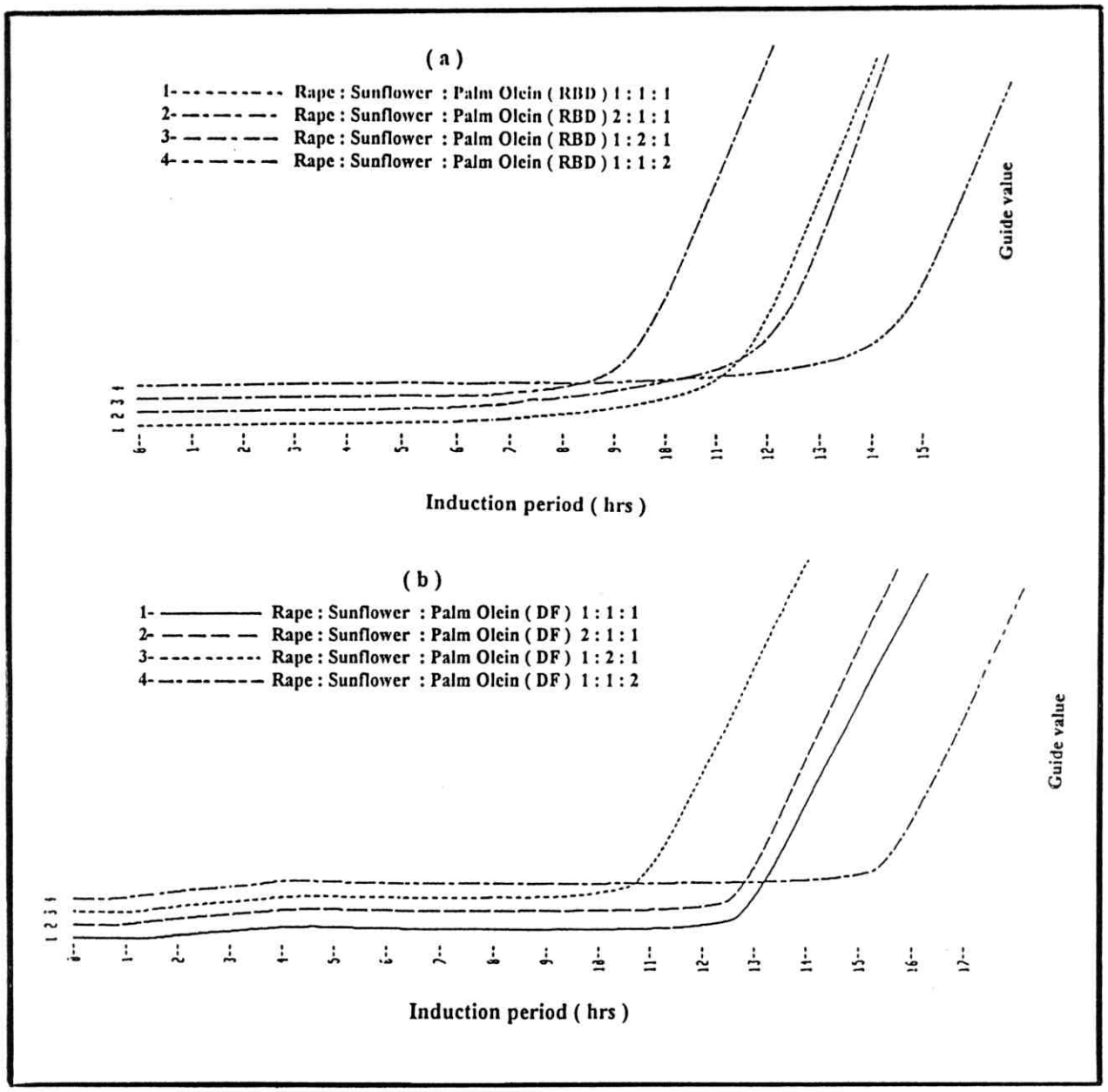


Fig. (12): Stability of blending Rapeseed oil with both:-
(a) Sunflower + Palm olein (RBD) and
(b) Sunflower + Palm olein (DF).

Table (14): Fatty acids composition of some edible oils.

Oil	Fatty acids composition %										Ts : M.un. : P.un.*	OX♦
	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:0}$	$C_{20:1}$	$C_{22:0}$	$C_{22:1}$		
Palm oil	0.89	43.08	3.03	41.53	11.06	0.19	0.21	----	----	----	47.21 : 41.53 : 11.25	0.198
Palm olein RBD	0.87	37.83	4.18	40.40	14.16	0.60	1.41	0.51	----	----	44.29 : 40.91 : 14.76	0.234
Palm olein DF	0.96	37.13	4.23	44.13	12.86	0.13	0.32	0.21	----	----	42.65 : 44.34 : 12.99	0.220
Palm sterien	0.90	51.48	3.67	35.77	8.06	0.10	0.11	----	----	----	56.16 : 35.77 : 8.16	0.154
Rape	0.05	3.29	1.61	43.92	16.83	9.91	0.62	8.18	0.47	15.13	6.04 : 67.23 : 26.74	0.454
Sunflower	0.68	6.33	3.11	24.22	65.12	0.28	0.23	----	----	----	10.35 : 24.22 : 65.40	0.705

*** Total Saturated : Monounsaturated : Polyunsaturated**

♦ Calculated oxidizability

The fatty acid composition of sunflower oil makes it desirable for use as an edible oil. It is relatively low in the saturated fatty acids, palmitic and stearic, while it contains only small amounts of linolenic acid (0.28%) and arachidic acid (0.23%). The low content of linolenic acid is primarily responsible for its excellent storage qualities, **Morrison (1975)**. Linoleic and oleic acids are the major fatty acid of sunflower oil, which represents as 65.12% and 24.22% respectively. The degree of unsaturation of sunflower oil has been found to be largely dependent upon the climatic conditions during the growing season, **Robertson (1972)**.

Traditional cookery provides a large market for liquid oil for domestic purposes. In some cases, where flavoured oils are desired, blends may be used with predominantly palm olein as the major base oil (**Second Arab Conference, 1993)**.

Palm olein RBD or palm olein DF in the present investigation were blended with either rapeseed oil or sunflower oil at different ratios. The obtained data shown in Tables (14, 14a and 14b) revealed a decrease in linoleic and linolenic acids. However, the reduction was noticed in linolenic acid from 9.91% in rapeseed oil to 5.62%, 6.27% and 5.47% at the ratios (5:5) of (rape:palm olein RBD), (rape:palm olein DF) and (rape:sunflower) respectively.

With regard to total saturated fatty acids, the value in rapeseed oil i.e. 6.04% increased to 27.13% and 20.58% in the blended oils at ratios (5:5) of (rape:palm olein RBD) and (rape:palm olein DF) respectively.

Blending sunflower oil with palm olein RBD, palm olein DF and rapeseed oil Table (14b) showed that oleic acid was increased from

Table (14a): Fatty acids composition of oil blends.

Oil blends	Fatty acids composition%										Ts : M.un. : P.un.*	OX♦
	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:0}$	$C_{20:1}$	$C_{22:0}$	$C_{22:1}$		
Rape : Palm olein BRD												
9 : 1	0.25	8.92	3.05	42.49	16.25	9.84	0.78	7.03	0.35	11.05	13.34 : 60.57 : 26.09	0.444
8 : 2	0.11	10.97	3.55	42.33	16.00	8.96	0.84	7.67	0.18	9.66	15.65 : 59.66 : 24.96	0.424
7 : 3	1.10	14.93	3.46	42.08	15.80	7.16	0.94	6.85	-----	8.28	20.43 : 57.21 : 22.96	0.386
6 : 4	0.53	17.85	3.17	41.95	15.78	6.90	0.98	5.73	-----	7.44	22.53 : 55.12 : 22.68	0.380
5 : 5	0.69	22.64	2.79	41.65	15.54	5.62	1.01	4.56	-----	6.00	27.13 : 52.21 : 21.16	0.351
Rape : Palm olein DF												
9 : 1	0.30	6.64	1.46	45.25	16.84	9.34	0.88	7.28	0.32	11.74	9.60 : 64.27 : 26.18	0.460
8 : 2	0.24	9.87	3.57	43.67	16.58	9.29	0.41	6.80	------	9.03	14.09 : 59.50 : 25.87	0.439
7 : 3	0.47	12.49	2.85	43.48	16.96	8.23	0.82	5.90	------	8.90	16.63 : 58.28 : 25.19	0.421
6 : 4	0.54	16.73	2.43	42.16	15.77	8.20	0.88	5.75	------	7.20	18.68 : 54.68 : 23.57	0.406
5 : 5	0.22	19.62	2.86	41.67	14.85	6.27	0.63	4.37	------	6.37	20.58 : 52.11 : 23.97	0.357
Rape : Sunflower												
9 : 1	-----	4.97	4.02	42.34	22.08	8.07	0.56	8.08	0.41	10.90	9.96 : 61.32 : 30.15	0.467
8 : 2	-----	4.81	4.36	36.97	28.07	7.57	0.47	7.74	0.33	9.58	9.97 : 54.29 : 35.64	0.506
7 : 3	-----	2.70	4.58	35.76	33.30	6.64	0.43	6.86	0.41	8.92	8.12 : 51.54 : 39.94	0.537
6 : 4	0.24	5.08	4.57	33.89	35.81	6.24	0.41	5.90	0.43	7.14	10.73 : 46.83 : 42.14	0.551
5 : 5	-----	5.10	4.54	33.76	38.49	5.47	0.39	5.30	0.42	6.42	11.45 : 44.18 : 43.96	0.562

Table (14b): Fatty acids composition of oil blends.

Oil blends	Fatty acids composition%										Ts : M.un. : P.un.*	OX◆
	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:0}$	$C_{20:1}$	$C_{22:0}$	$C_{22:1}$		
Sunflower: Palm olein BRD												
9 : 1	0.68	10.36	3.60	25.59	58.98	0.33	0.23	0.10	---	---	14.87 : 25.96 : 59.31	**0.648**
8 : 2	0.70	13.57	3.80	27.99	52.91	0.37	0.32	0.11	---	---	10.39 : 28.10 : 53.28	**0.593**
7 : 3	0.77	14.73	3.76	28.68	50.42	0.40	0.78	0.17	---	---	20.04 : 28.85 : 50.82	**0.570**
6 : 4	0.75	19.20	3.87	30.77	44.58	0.40	0.50	0.18	---	---	24.32 : 30.95 : 44.98	**0.515**
5 : 5	0.76	26.24	3.98	31.80	36.06	0.46	0.72	0.22	---	---	31.70 : 32.02 : 36.52	**0.434**
Sunflower: Palm olein DF												
9 : 1	0.69	9.60	3.23	26.38	59.32	0.43	0.25	0.05	---	---	13.77 : 26.43 : 59.75	**0.655**
8 : 2	0.72	12.98	3.39	28.20	53.14	1.23	0.27	0. 08	---	---	17.36 : 28.28 : 54.37	**0.612**
7 : 3	0.75	15.42	3.48	29.76	49.25	1.24	0.27	0 .08	---	---	19.92 : 30.03 : 50.49	**0.557**
6 : 4	0.76	18.31	3.42	31.46	44.36	1.24	0.29	0.11	---	---	22.78 : 31.57 : 45.60	**0.531**
5 : 5	0.84	22.34	3.69	33.78	38.76	0.25	0.30	0.18	---	---	26.87 : 33.96 : 39.01	**0.460**
Sunflower: Rape												
9 : 1	0.44	5.92	2.80	26.30	59.71	1.93	0.60	1.61	0.05	1.29	9.81 : 28.75 : 61.64	**0.688**
8 : 2	0.40	5.11	2.95	29.23	54.45	2.86	0.58	1.92	0.11	2.80	9.15 : 33.95 : 57.31	**0.660**
7 : 3	0.38	5.10	3.00	30.69	50.11	3.40	0.53	2.60	0.23	3.95	9.24 : 37.24 : 53.51	**0.631**
6 : 4	0.30	4.70	3.00	32.79	45.37	4.35	0.50	3.76	0.38	4.95	8.88 : 41.50 : 49.72	**0.606**
5 : 5	0.22	4.63	3.10	33.56	39.59	5.39	0.42	5.76	0.40	6.99	8.77 : 46.31 : 44.98	**0.571**

24.22% in sunflower oil to 31.80%, 33.78% and 33.56% in the (sunflower, palm olein RBD, 5:5), (sunflower:palm olein DF, 5:5) and (sunflower:rape, 5:5) respectively. While linoleic acid was decreased sharply from 65.12% in sunflower to 36.06%, 38.76% and 39.59% respectively in the previous blends under experiment.

The fatty acid compositions of blending rapeseed oil with both sunflower oil and palm olein RBD or palm olein DF are shown in Table (14c). The obtained data indicated that the blends of (rape:sunflower:palm olein RBD) and (rape:sunflower:palm olein DF) at ratios (1:1:2) gave encouragement results for blending.

From the previous results, it could be noticed that the blends at ratios (5:5) of sunflower oil with palm olein RBD or palm olein DF gave the best ratios for saturated(S):monounsaturated(M):polyunsaturated(P) i.e. (1:1.01:1.15) and (1:1.26:1.45). Such ratios followed by blending of rapeseed oil with both sunflower oil and palm olein DF or palm olein RBD at ratios (1:1:2). The values reached to (1:1.56:1.101) and (1:1.57:1.11) for S:M:P. The obtained data are in accordance with **Teah and Ibrahim (1991)**. The authors stated that the cost benefit as well as technical and nutritional advantages could be fully exploited. It has been advantages that for optimum nutritional benefits, the ratio for saturated: monounsaturated: polyunsaturated fatty acids is recommended as (1:1:1).

Also, the same authors added the blending is the most economical process for fat modification, in the case of fat for deep frying, it has a similar effect to partial hydrogenation i.e. reduction of linoleic and

Table (14c): Fatty acids composition of oil blends.

Oil blends	Fatty acids composition %										Ts : M.un. : P.un.*	OX♦
	$C_{14:0}$	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$	$C_{20:0}$	$C_{20:1}$	$C_{22:0}$	$C_{22:1}$		
Rape : Sun: Palm olein BRD												
1 : 1: 1	0.29	16.90	3.22	36.87	34.17	3.10	0.25	1.63	----	3.59	20.66 : 42.09 : 37.27	0.477
2 : 1: 1	0.88	13.96	4.51	39.34	27.98	3.33	0.39	3.41	0.25	5.97	19.99 : 48.72 : 31.31	0.425
1 : 2: 1	0.62	16.99	4.16	34.17	35.67	2.47	0.42	1.62	0.37	3.51	22.56 : 39.30 : 38.14	0.474
1 : 1: 2	0.68	22.03	3.25	37.51	26.77	3.38	0.75	2.21	0.46	2.97	27.17 : 42.70 : 30.15	0.410
Rape : Sun: Palm olein DF												
1 : 1: 1	0.37	14.29	3.26	36.02	32.21	4.52	0.76	3.62	0.38	4.58	19.06 : 44.22 : 36.72	0.485
2 : 1: 1	0.31	12.84	2.52	39.80	28.86	4.91	0.40	3.22	0.38	6.78	16.45 : 49.80 : 33.76	0.466
1 : 2: 1	0.66	13.29	3.11	33.75	39.30	3.27	0.44	2.69	0.33	3.16	17.83 : 39.59 : 42.58	0.526
1 : 1: 2	1.49	21.36	4.43	37.61	25.74	2.38	0.26	1.95	0.45	4.34	27.98 : 43.89 : 28.12	0.380

linolenic acid contents but without the introduction of the trans fatty acid associated with hydrogenation.

It has to be mentioned that, the calculated oxidizability is inversely proportional to stability of blending oils which calculated as: **0.2 (oleic %) + (lenoleic %) + 2 (linolenic %) / 100 GC area percent compositions** according to **Neff *et al.* (1994).**

The data shown in Tables (14, 14a, 14b and 14c) showed that the oxidizability of rapeseed oil i.e. (0.454) was decreased to (0.351) and (0.357) at ratios (5:5) of blending rape with palm olein RBD or with palm olein DF respectively.

On the other hand, the oxidizability of rapeseed oil (0.454) led to increase by blending with sunflower oil. Such value reached to (0.562) at ratio (5:5). The increase in oxidizability may be attributed to decrease in oleic acid content and increase in linoleic acid content by blending.

The calculated oxidizability of sunflower oil was (0.705). However, this value was decreased to (0.434), (0.460) and (0.571) for (sunflower:palm olein RBD), (sunflower: palm olein DF) and (sunflower: rapeseed oil) at the same ratios (5:5) respectively.

It could be deduced from the obtainable data that blending of rapeseed oil or sunflower oil with palm olein RBD or palm olein DF would be expected to improve the stability of such oils. In addition, the ratios of linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) to oleic ($C_{18:1}$) were decreased in the blending oils under investigations.

Nor Aini *et al.* (1992) confirmed that the good frying properties of palm olein are due to mainly to moderate the degree of unsaturation,

vertual absence of linolenic acid and the presence of oleic acid as the main faty acids combined with a high level of tocopherols which enhances its oxidative stability. This is the basis for the use of palm olein in heavy duty application in industrial frying where resistance to oxidation and polymerization are of paramount importance.

3.2.4 The unsaponfiable matter of some edible oils & blends:

Quantitation of the unsaponifiable matter of fats and oils is one of the more important analytical determinations in lipid chemistry. A significant segment of the fat and oil industry uses the value obtained as to be the basis for the buying and selling of fats and oil, **Kornfeldt and Børjecon (1981).**

From the data presented in Table (15), the hydrocarbons of palm oil and its fractions could be divided into three groups. First the predominant hydrocarbon fractions on major group (>9%) which contains C_{21}, it percentage ranged from (20.25% to 24.88%) for palm olein DF and palm olein RBD respectively. The second group, represents moderate component (>5.00% to 9.00%), comprised of C_{30}, C_{28}, C_{25}, C_{24}, C_{23} and C_{20}. The third group represents minor components (<5) include C_{16} and C_{22}.

The same data tabulated in Table (15), showed that, the β-sitosterol was the major sterol fraction of total sterol followed by campesterol and stigmasterol, their percentages were ranged from (19.26% to 22.20%), (5.54% to 6.95%) and (3.94% to 5.56%) respectively. These results agreed with those obtained by **Itoh *et al.* (1973)** for palm oil.

Table (15): Hydrocarbons and sterols composition of the unsaponifiable matter of some edible oils.

Oil	Hydrocarbon %									Sterol %				Hy.* %	St.** %
	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{28}	C_{30}	Brassica-sterol	Camp-sterol	Stigm-sterol	β.Sito.-sterol		
Palm oil	7.21	20.26	2.14	7.56	6.20	7.10	3.27	8.14	7.02	----	6.12	4.34	20.91	68.90	31.37
Palm olein RBD	8.39	24.88	2.88	6.67	5.20	6.28	3.66	6.12	7.90	----	5.54	3.94	19.26	71.98	28.74
Palm olein DF	7.30	20.25	2.56	5.48	5.43	6.30	4.33	7.62	7.97	----	6.27	4.92	21.52	67.24	32.71
Palm sterien	7.34	21.13	2.10	6.11	3.65	6.32	4.82	5.57	7.34	----	6.95	5.56	22.20	64.38	34.71
Rape	2.37	2.85	10.11	2.52	3.70	41.10	3.63	2.55	2.83	4.30	6.16	1.49	16.91	69.11	30.68
Sunflower	----	2.21	4.16	1.74	2.88	9.13	2.97	16.75	5.61	----	6.13	2.38	47.21	44.45	55.72

* Total hydrocarbon

** Total sterol

Table (15): Hydrocarbons and sterols composition of the unsaponifiable matter of some edible oils.

Oil	Hydrocarbon %									Sterol %				Hy.* %	St.** %
	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{28}	C_{30}	Brassica-sterol	Camp-sterol	Stigm-sterol	β.Sito.-sterol		
Palm oil	7.21	20.26	2.14	7.56	6.20	7.10	3.27	8.14	7.02	----	6.12	4.34	20.91	68.90	31.37
Palm olein RBD	8.39	24.88	2.88	6.67	5.20	6.28	3.66	6.12	7.90	----	5.54	3.94	19.26	71.98	28.74
Palm olein DF	7.30	20.25	2.56	5.48	5.43	6.30	4.33	7.62	7.97	----	6.27	4.92	21.52	67.24	32.71
Palm sterien	7.34	21.13	2.10	6.11	3.65	6.32	4.82	5.57	7.34	----	6.95	5.56	22.20	64.38	34.71
Rape	2.37	2.85	10.11	2.52	3.70	41.10	3.63	2.55	2.83	4.30	6.16	1.49	16.91	69.11	30.68
Sunflower	----	2.21	4.16	1.74	2.88	9.13	2.97	16.75	5.61	----	6.13	2.38	47.21	44.45	55.72

* Total hydrocarbon

** Total sterol

From the data presented in Table (15), it could be observed that, the hydrocarbon of the rapeseed oil constituted the major part of the unsaponifiable which contained 9 different components amounted 69.11% of the total unsaponifiable matter of rapeseed oil under investigatoin, it contained C_{25} as a major constituent amounted 41.10% while C_{22} was present in moderate amounts. Moreover, other hydrocarbons C_{20}, C_{21}, C_{23}, C_{24}, C_{26}, C_{28} and C_{30} were found in relatively small amounts.

β-sitosterol, stigmasterol and campesterol were detected in rapeseed oil, their total amount was 28.86%, β-sitosterol was the main sterol comprised as 16.91% while campesterol was present in moderate amount 6.16%. Data presented in Table (15) indicated that, rapeseed oil contain brassicasterol, a C_{28} sterol (4.30%) characteristic of Brassica oil, it does not occur in other common edible vegetable oils. Brassicasterol is thus a key factor in identifying Brassica oils either by themselves or after blending with other edible oils **Ackman (1983)**. These findings are near with those of **Shabana *et al.* (1990) and Rady *et al.* (1990).**

From the data listed in Table (15) it can be seen that the unsaponifiable matter of sunflower oil consisted mainly of hydrocarbons (44.45%) and sterols (55.72%). Eight hydrocarbons were identified in sunflower oil. The main hydrocarbons were C_{28} and C_{25}, which represents as 16.75% and 9.13% from the total unsaponifiable matter respectively.

The sterol composition of sunflower unsaponifiables consisted mainly of three compounds being stigmasterol , campesterol and β-sitosterol. β-sitosterol was detected in sunflower oil as the major sterol

content (47.21%). These results are agreement with those obtained by **Abd El-Rahman (1991).**

Blending rapeseed oil with palm olein RBD, palm olein DF and sunflower (Table 15a) lead to decrease in C_{25} hydrocarbon. Its value decrease from 41.10% in pure rapeseed oil to 21.33%, 22.12% and 27.32% in (rape : palm olein RBD, 5:5), (rape : palm olein DF, 5:5) and (rape : sunflower 5:5) respectively.

From the data presented in Table (15a) its clear that, the Brassica sterol which characteristic of Brassica oil (rapeseed oil) decreased from 4.30% for pure oil to 2.70%, 2.64% and 2.36%, in same above ratios of blending oils. However β-sitosterol increased from 16.91% in pure oil to 18.09%, 20.73% and 32.09% in (rape : palm olein RBD, 5:5), (rape : palm olein DF, 5:5) and (rape : sunflower, 5:5) respectively.

Blending sunflower oil with palm olein RBD, palm olein DF or rapeseed oil Table (15b) caused C_{28} hydrocarbon decrease from 16.75% to 11.62%, 10.99% and 9.82% in blending the above oils with ratios (5:5), while total sterols decreased from 55.72% in pure sunflower oil to 41.20%, 44.95% and 45.82% in same blending oils.

From the data tabulated in Table (15c) it's clear that, the total sterol detected in high percentage in blending rapeseed oil with both sunflower and palm olein RBD or DF at ratios (1:1:2) and (1:2:1) respectively.

content (47.21%). These results are agreement with those obtained by **Abd El-Rahman (1991).**

Blending rapeseed oil with palm olein RBD, palm olein DF and sunflower (Table 15a) lead to decrease in C_{25} hydrocarbon. Its value decrease from 41.10% in pure rapeseed oil to 21.33%, 22.12% and 27.32% in (rape : palm olein RBD, 5:5), (rape : palm olein DF, 5:5) and (rape : sunflower 5:5) respectively.

From the data presented in Table (15a) its clear that, the Brassica sterol which characteristic of Brassica oil (rapeseed oil) decreased from 4.30% for pure oil to 2.70%, 2.64% and 2.36%, in same above ratios of blending oils. However β-sitosterol increased from 16.91% in pure oil to 18.09%, 20.73% and 32.09% in (rape : palm olein RBD, 5:5), (rape : palm olein DF, 5:5) and (rape : sunflower, 5:5) respectively.

Blending sunflower oil with palm olein RBD, palm olein DF or rapeseed oil Table (15b) caused C_{28} hydrocarbon decrease from 16.75% to 11.62%, 10.99% and 9.82% in blending the above oils with ratios (5:5), while total sterols decreased from 55.72% in pure sunflower oil to 41.20%, 44.95% and 45.82% in same blending oils.

From the data tabulated in Table (15c) it's clear that, the total sterol detected in high percentage in blending rapeseed oil with both sunflower and palm olein RBD or DF at ratios (1:1:2) and (1:2:1) respectively.

Table (15a): Hydrocarbons and sterols composition of the unsaponifiable matter of oil blends.

Oil blends	Hydrocarbon %									Sterol %				Hy.* %	St.** %
	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{28}	C_{30}	Brassica-Sterol	Camp-Sterol	Stigm-Sterol	β.Sito-Sterol		
Rape : Palm olein BRD															
9 : 1	2.50	6.88	4.94	3.42	3.96	37.52	3.46	3.17	2.47	4.72	7.45	1.86	17.82	68.32	31.85
8 : 2	2.41	7.92	4.43	4.50	4.14	36.03	3.28	3.31	2.89	4.09	7.29	2.18	17.49	68.91	31.05
7 : 3	2.75	9.70	3.71	4.81	4.11	33.60	3.53	3.94	3.56	3.87	6.88	2.14	17.63	69.71	30.52
6 : 4	2.11	12.19	3.71	4.90	4.22	28.15	3.60	4.16	4.91	3.36	6.55	2.38	17.94	69.95	30.23
5 : 5	6.59	14.34	3.68	5.31	4.30	21.33	3.05	4.82	6.98	2.70	6.16	2.61	18.09	70.40	29.56
Rape : Palm olein DF															
9 : 1	2.49	6.76	4.95	3.31	3.98	37.56	3.18	3.97	2.31	4.17	7.14	1.94	18.17	68.51	31.42
8 : 2	2.56	6.99	4.47	3.16	4.02	36.80	3.14	4.18	2.39	4.09	7.08	2.28	18.79	67.71	32.24
7 : 3	3.63	9.03	4.00	3.30	4.10	33.22	3.13	4.20	3.60	3.73	6.76	2.32	19.17	68.21	31.98
6 : 4	4.95	11.03	3.66	3.66	4.17	29.04	3.25	4.45	4.99	3.29	6.54	2.64	19.26	69.20	31.73
5 : 5	5.76	12.22	3.51	3.76	4.29	22.12	4.35	4.67	7.28	2.64	6.46	2.78	20.73	67.96	32.61
Rape : Sunflower															
9 : 1	2.14	2.73	3.65	2.18	3.86	36.52	3.173	3.84	2.63	3.69	7.22	1.66	26.98	60.72	39.55
8 : 2	1.80	2.54	3.43	2.07	3.64	35.17	3.19	4.84	2.83	3.45	7.08	1.76	28.17	59.51	40.46
7 : 3	1.70	2.42	3.16	2.00	3.09	33.39	3.21	6.54	3.49	3.10	6.57	1.85	29.60	59.00	41.12
6 : 4	1.49	2.46	3.02	1.95	3.14	32.21	3.29	7.24	4.34	2.53	6.31	1.99	30.00	59.14	40.83
5 : 5	1.53	2.43	3.05	1.88	3.05	27.32	3.37	9.86	4.61	2.36	6.17	2.25	32.09	57.10	42.87

Table (15b): Hydrocarbons and sterols composition of the unsaponifiable matter of oil blends.

Oil blends	Hydrocarbon %									Sterol %				Hy.* %	St.** %
	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{28}	C_{30}	Brassica-sterol	Camp-sterol	Stigm-sterol	β.Sito.-sterol		
Sunflower : Palm olein BRD															
9 : 1	2.34	4.65	2.18	2.33	3.20	9.26	3.03	15.98	5.26	----	6.12	2.46	43.52	48.23	52.10
8 : 2	2.72	6.53	2.27	2.85	3.45	8.79	3.16	14.78	5.43	----	5.99	2.61	41.87	49.98	50.47
7 : 3	3.14	8.17	2.22	3.29	4.06	8.97	3.17	13.64	5.99	----	5.97	2.89	38.75	52.65	47.61
6 : 4	3.43	11.30	2.27	3.68	4.14	8.65	3.37	12.63	6.14	----	5.96	3.07	35.69	55.61	44.72
5 : 5	4.94	14.80	2.32	4.04	4.44	7.61	3.36	11.62	6.35	----	5.81	3.06	32.33	59.12	41.20
Sunflower : Palm olein DF															
9 : 1	1.42	3.82	2.16	2.81	3.12	9.53	3.16	15.38	5.24	----	6.15	2.61	44.55	46.64	53.31
8 : 2	2.34	5.38	2.29	2.73	3.64	8.56	3.25	14.59	5.34	----	6.17	2.84	42.94	48.07	51.95
7 : 3	2.99	7.58	2.36	3.03	3.78	8.77	3.36	13.89	5.79	----	6.18	3.16	39.34	51.55	48.68
6 : 4	3.26	9.37	2.30	3.38	4.63	8.70	3.65	11.05	6.25	----	6.35	3.48	37.67	52.59	47.50
5 : 5	3.62	11.39	2.45	3.89	4.76	7.88	3.84	10.99	6.52	----	6.92	3.55	34.48	55.34	44.95
Sunflower : Rape															
9 : 1	0.52	2.18	2.24	1.73	2.62	14.36	2.97	15.61	2.41	4.68	6.32	2.29	42.44	44.64	55.74
8 : 2	0.68	2.11	2.58	1.96	2.81	16.37	3.00	13.39	2.84	4.47	6.49	2.16	41.62	45.74	54.74
7 : 3	0.82	2.36	2.94	2.11	3.13	19.31	3.00	12.36	3.40	4.11	6.55	2.15	37.68	49.47	50.49
6 : 4	1.05	2.44	3.16	2.26	3.17	21.13	3.01	11.37	4.23	2.69	6.65	1.92	36.87	51.82	48.13
5 : 5	1.34	2.58	3.48	2.37	3.25	23.54	3.00	9.82	4.84	2.31	6.98	1.78	34.75	54.22	45.82

Table (15c): Hydrocarbons and sterols composition of the unsaponifiable matter of oil blends.

Oil blends	Hydrocarbon %									Sterol %				Hy.* %	St.** %
	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}	C_{28}	C_{30}	Brassica-sterol	Camp-sterol	Stigm-sterol	β.Sito.-sterol		
Rape : Sun : Palm olein BRD															
1 : 1 : 1	3.00	8.38	2.49	3.92	4.60	20.09	3.77	8.94	4.62	2.46	6.44	2.98	28.76	59.81	40.64
2 : 1 : 1	4.60	7.45	3.39	3.86	4.58	23.52	3.80	6.09	3.26	2.35	6.68	2.63	27.75	60.55	39.41
1 : 2 : 1	2.37	7.26	3.07	2.92	4.19	20.01	3.10	10.19	5.56	1.97	5.73	2.68	31.01	58.67	41.39
1 : 1 : 2	3.27	7.40	2.33	3.07	3.13	20.41	3.25	7.62	5.59	1.76	5.97	3.34	33.23	56.07	44.30
Rape : Sun : Palm olein DF															
1 : 1 : 1	3.11	10.25	2.50	3.39	4.96	19.10	3.29	8.57	4.05	2.66	6.52	2.89	29.13	59.22	41.20
2 : 1 : 1	4.03	8.83	3.09	3.84	4.06	24.28	3.18	7.54	3.76	2.36	6.67	2.69	26.18	62.61	37.84
1 : 2 : 1	1.71	7.07	3.71	2.27	4.39	20.34	3.02	8.44	5.24	1.87	6.21	2.38	34.26	56.19	44.72
1 : 1 : 2	3.60	8.12	2.85	3.44	3.53	22.29	3.52	7.45	5.44	1.69	6.54	3.44	27.98	60.24	39.65