IV. SUMMARY

The aim of this work was to study the possibility of using safe doses of gamma rays (up to 10 KGY), dry heat treatments (roasting), humid heat treatments (autoclaving) as well as various soaking treatments to inactivate or minamize the antiqualites factors of rapeseed (glucosinolate compounds and myrosinase enzyme) and detect the effects of these treatments on chemical composition of oil and residual meal.

Attention was focused on the effect of these treatments on the chemical composition, fatty acids constituents and unsaponifiable matter components of rapeseed oil. Besides, the changes occurred in the chemical composition, total glucosinolate compounds and myrosinase enzyme activity of residual meal of rapeseed were also studied.

The obtained results could be summarized as follows :

IV. 1. Untreated rapeseeds :

IV.1.1. Physical and chemical properties of rapeseeds oil :

Refractive index at 25°C, specific gravity at 25°C, acid value, peroxide value, iodine value, saponification value and unsaponifiable matter percentage of crude rapeseed oil were determined and the obtained results found to be 1.4693, 0.9115, 0.72, 3.328, 106.95, 190.36 and 1.70, respectively.

IV.1.2. Fatty acid composition of rapeseeds oil :

Using G.L.C., the fatty acids constituents were fractionated where eight acids were found to be present as follows : undecanoic acid (11:0) 0.83%, palmitic acid (16:0) 3.71%, stearic acid (18:0) 0.27%, oleic acid (18:1) 76.52%, linoleic acid (18:2) 10.29%, linolenic acid (18:3) 6.13%, arachedic acid (20:0) 1.42% and erucic acid (22:1) 0.83%.

IV.1.3. Unsaponifiable matter components of rapeseeds oil :

Unsaponifiable matter was fractionated using G.L.C. technique and twenty-one components were separated. Among these components nineteen compounds were identified and the other were still unknown. Total hydrocarbons were 84.25% and C_{24} (46.48%) was the predominant compound, followed by UCC_{32} (3.74%) while, B-sitosterol was the main compounds of sterols (8.32%) followed by campesterol (1.69%).

IV.1.4. Chemical composition of rapeseeds meal :

The residual meal of untreated rapeseed was analysed for its total glucosinolate compounds, moisture, protein, crude fibre, reducing + non-reducing sugars, ash and its elements of Na, K, Zn, Cu and Mn. The percentages were 1.88 g/100 g , 9.28%, 34.63%, 8.46%, 4.60%, 7.04%, 0.022%, 0.44%, 0.16%, 0.037% and 0.08% based on dry basis, respectively.

IV. 2. Effect of gamma irradiation on extracted oil and meal of rapeseed :

Rapeseeds were subjected to gamma rays doses (0.5, 2.0, 3.5, 5.0, 6.5, 8.0 and 9.5 KGY) and the changes occurred in both oil and residual meal were determined.

IV.2.1. Physical and chemical properties of rapeseeds oil :

Gamma irradiation doses had a minute effects on refractive index, specific gravity, iodine value, saponification value and unsaponifiable matter percentage, while acid value and peroxide value showed a gradual decrease with increasing gamma doses which mostly attributed to the hydrolizing effect of these rays.

IV.2.2. Fatty acids composition of rapeseed oil :

The ascending doses of gamma irradiation induced a gradual increase in linoleic acid (18:2) and gradual decrease in linolenic acid (18:3), undecanoic acid (11:0) and erucic acid (22:1), while the other fatty acids showed a minor changes in their relative percentages due to gamma irradiation.

IV.2.3. Unsaponifiable matter components of rapeseeds oil :

Among hydrocarbons, the predominant hydrocarbon (C_{24}) showed a marked increase, while both saturated and unsaturated C_{32} as well as C_{16} showed some decrease due to gamma irradiation.

As for sterols, capesterol was increased while stigmasterol and B-sitosterol showed a noticeable decrease followed by marked increase when seeds subjected to 2.0 and 9.5 KGY, respectively. In addition, some new components appeared and other ones disappeared due to gamma irradiation. Some new hydrocarbons were originated after irradiation. It seems that the radiolytic breakdown of triglycerides yields a series of saturated and unsaturated hydrocarbons which depends on the glyceride fatty acids composition.

IV.2.4. Chemical composition of rapeseeds meal :

The percentages of moisture, crude fibre, protein, ash, Na, K, Zn, Cu and Mn were slightly changed, while reducing and non-reducing sugars were increased due to gamma irradiation. It also lead to a decrease in both total glucosinolates and myrosinase enzyme activity and the reduction percentage reached to 4.26% and 19.32% in irradiated samples at 9.5 KGY, respectively.

IV.3. Effect of humid and dry heat treatments on extracted oil and meal of rapeseeds :

Rapeseeds were autoclaved at 120°C/1.5 p.s.i. for 5, 10 and 20 min. and roasted at 100, 120 and 140°C for 30 and 60 min. The changes took place as a result of these treatments were determined.

IV.3.1. Physical and chemical properties of rapeseeds oil :

The peroxide value was increased and the rate of increase was higher in autoclaving than in roasting treatments. While both acid value and iodine number were decreased due to roasting and autoclaving treatments. Meanwhile, refractive index, specific gravity, saponification value and unsaponifiable matter showed a slight changes as a results of these heat treatments.

IV.3.2. Fatty acids composition of rapeseeds oil :

Generally, palmetic acid ($C_{16:0}$) and oleic acid (18:1) were increased, while lenoleic acid (18:2), lenolenic acid (18:3) and erucic acid (22:1) were decreased due to autoclaving and roasting treatments. Moreover, other fatty acids showed a slight changes as a results of these treatments. The observed decrease in linoleic (18:2) and linolenic acids (18:3) which was also noticed in the last treatment i.e. irradiation, might be attributed to the dimerization process and/or further polymerization and were no longer measured as such by G.L.C. with column used.

IV.3.3. Unsaponifiable matter components of rapeseeds oil :

Both autoclaving and roasting treatments induced a remarkable changes in relative percentage of unsaponifiable matter components.

C_{18}, C_{24}, C_{28}, unk.$_{13}$ and C_{32} showed a noticeable decrease while C_{20}, campesterol, stigmasterol and B-sitosterol were increased due to autoclaving. Roasting rapeseed at 120°C for 30 min. induced an a cute increase in C_{10} and C_{12} and a noticeable increase in Unk (10), campesterol and B-sitosterol. On the other hand, roasting seed at 120°C for 60 min. increased the hydrocarbons C_{10}, C_{20}, C_{24}, stigmasterol and B-sitosterol.

IV.3.4. Chemical composition of rapeseeds meal :

Autoclaving treatments had almost no effect on all chemical composition of rapeseeds meal except reducing and non-reducing sugar which showed a remarkable decrease due to this treatments. Moreover, roasting treatments decreased moisture content and increased reducing + non-reducing sugar, while ash, crude fibre, protein and Na, K, Zn, Cu and Mn of rapeseed meal showed a minor changes due to this treatments. Autoclaving treatments had little effect on total glucosinolates and myrosinase enzyme activity as the reduction percentage reached only to 6.38% and 9.09% for sample autoclaved at 120°C/1.5 p.s.i. for 20 min., respectively. While, roasting treatments had a great effect on either reduction amount of total glucosinolate compounds or inactivation of myrosinase enzyme activity. The reduction percentage reached to 84.04% and 94.32% in rapeseed roasted at 140°C for ±60 min., respectively.

IV. 4. Effect of various soaking treatments on extracted oil and meal of rapeseeds :

IV.4.1. Physical and chemical properties of rapeseeds oil :

Rapeseeds were soaked in tap water, hot water and 2% NaOH solution for different periods and changes occurred in both oil and residual meal were detected.

Acid value, peroxide value and iodine value were decreased while other properties showed a slight changes due to soaking in tap water. Soaking rapeseeds in hot water increased both acid value and peroxide value and decreased iodine value, while the other properties slightly changed due to this treatments. Moreover, soaking rapeseeds in 2% NaOH decreased both iodine value and acid value and sharply increase peroxide value.

IV.4.2. Fatty acids composition of rapeseeds oil :

Soaking rapeseeds in tap water increased palmetic acid (16:0) and the decrease of undecanoic acid (11:0), lenolenic acid (18:3) and erucic acid (22:1) while other acids were slightly changed. In addition, soaking rapeseeds in hot water (70°C) decreased undecanoic acid (11:0), lenolenic acid (18:3), araohedic acid (20:0) and erucic acid (22:1) and the increases in oleic acid (18:1) and palmetic acid (16:0). Lenoleic acid (18:2) showed a fluctuation trend due to this treatments.

IV.4.3. Unsaponifiable matter components of rapeseeds oil :

Various soaking treatments induced a remarkable changes in the relative percentages of unsaponifiable matter components of rapeseeds oil. These treatments caused decreases in C_{14}, C_{16}, C_{18}, squalene, C_{30}, UC_{32} and C_{32}, while, campesterol and B-sitosterol were increased. Moreover, some components disappeared while other ones were identified due to these treatments.

IV.4.4. Chemical composition of rapeseeds meal :

All soaking treatments had almost no effect on moisture, protein and all minerals except sodium element in sample soaked in NaOH solution, which showed ofcourse a marked increase in its content • crude fibre and reducing + non-reducing sugar were decreased by all soaking treatments. Furthermore, ash content was decreased by soaking rapeseeds in tap water and hot water, while it increased by soaking seeds in 2% NaOH solution. On the other hand, soaking rapeseeds in 2% NaOH had more effect of both glucosinolate compounds and myrosinase enzyme activity, followed by soaking in tap water and hot water.

Generally, it could be concluded that roasting treatments had the highest reduction in either myrosinase enzyme activity or total glucosinolate comomds as compared with the other treatments, since the reduction percentage reached 94.32% and

84.04% in myrosinase enzyme activity and total glucosinolate, respectively. From the pervious treatments and the obtained results, we could be highely recommended roasting rapeseed at 120°C for 30 min. to inactivate myrosinase enzyme and reduce its glucosinolate compound.