# INFLUENCE OF RAPESEED OIL LEVEL AND PECTIN ON GROWTH, LIPIDS AND PROTEIN IN RATS

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## INTRODUCTION

This work is a continuation of our previous research concerning the influence of some dietary fiber (agar, low methoxyl pectin and high methoxyl pectin) on rats fed on diets to which high erucic acid rapeseed oil (HEAR oil) was added (Chalcarz et al 1987).

The present study was undertaken to assess the influence of high methoxyl pectin (HMP) on growth, weights of internal organs, serum protein and serum and hepatic lipids of rats fed on isocaloric diets with HEAR oil which provided from 18 to 53% of calories.

## MATERIALS AND METHODS

Male Wistar rats weighing 70g were randomly divided into 6 groups of 8 animals and housed in quarters maintained at 20°C. The animals were provided with one of 6 diets and also with water ad libitum for 90 days. The composition of the diets is shown in Table 1. All diets were isocaloric.

Rats were weighed every 10 days. The animals were fasted for 24 h prior to collection of blood by heart puncture (under ether anasthesia). The liver, kidneys, heart, spleen, testes and brain were removed and weighed. Blood was analysed for fasting levels of triglycerides (Chromy et al 1977), total lipids, total cholesterol, free cholesterol, total protein, major protein fractions (Tomaszewski 1970). Liver was homogenized in 20 volumes of chloroform methanol mixture according to Folch et al (1957). The lipid

Table 1. Composition of test diets (g/1000g)

| Component | Diets | | | | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| casein | 131 | 131 | 131 | 131 | 131 | 131 |
| HEAR oil | 78 | 78 | 112 | 146 | 180 | 214 |
| wheat starch | 741 | 645 | 564.75 | 484.50 | 404.25 | 324 |
| HMP | - | 96 | 96 | 96 | 96 | 96 |
| vitamin mixture | 10 | 10 | 10 | 10 | 10 | 10 |
| salt mixture | 40 | 40 | 40 | 40 | 40 | 40 |
| water | - | - | 46.25 | 92.5 | 138.75 | 185 |

extracts were analysed for total fat and for total fatty acids (TFA) and were separated for major lipid classes (Kates 1972). The composition of triglycerides and free fatty acids was analysed by GLC (Kates 1972) and cholesterol by spectrophotometric method (Tomaszewski 1970). All data are expressed as means ± SD and differences between means were assessed by analysis of variance (Caliński and Wagner 1974).

## RESULTS AND DISCUSSION

Total weight changes and organ weights are shown in Table 2. Decrease in body weight, body weight gains and weights of internal organs induced by HEAR oil have been reported earlier (Borg 1975, Ziemlański 1977, Kramer et al 1983). It is interesting that diet IV (26% energy from HEAR oil) did not significantly lower weights of testes and heart in comparison to diets I-III. (18-27.5% of energy from HEAR - oil). Since in our earlier studies (Chalcarz et al 1987) diets with HMP significantly altered weight of heart and testes in comparison to diet without pectin, it may suggest that HMP can depress disadvantageous effect of erucic acid on weights of internal organs.

Concentrations of circulating lipids and protein are summarised in Table 3. Increased level of HEAR oil caused an increase in concentrations of total lipids and triglycerides, except diet VI. Decreased levels of triglycerides, free fatty acids, and protein in rats fed on diet VI, seem to be a typical sign of the exhaustion.

Table 2. Dietary effects on animal weights, animal weight gains and organ weights (g)

| Measurement | Diets | | | | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| initicl body weight | 70.1±18.2 | 72.3±15.7 | 67.1±4.8 | 67.3±15.7 | 65.8±5.7 | 67.9±13.3 |
| final body weight | 327.8±39.8$^{a}$ | 296.9±41.5$^{a}$ | 269.3±43.3$^{a}$ | 238.9±49.4$^{b}$ | 204.8±35.6$^{b}$ | 133.6±22.7$^{c}$ |
| body weight gain | 258.3±39.4$^{a}$ | 227.0±34.0$^{a}$ | 209.8±42.8$^{a}$ | 174.7±47.3$^{b}$ | 159.3±36.0$^{b}$ | 73.0±20.8 |
| liver weight | 11.1±1.0$^{a}$ | 10.3±1.5$^{a}$ | 9.8±1.7$^{a}$ | 9.7±1.3$^{a}$ | 8.0±1.5$^{b}$ | 6.9±1.0$^{b}$ |
| kidney weight | 2.6±0.4$^{a}$ | 2.2±0.4$^{a}$ | 2.1±0.4$^{a}$ | 1.9±0.3$^{b}$ | 1.7±0.3$^{b}$ | 1.4±0.2$^{b}$ |
| hart weight | 1.1±0.1$^{a}$ | 1.1±0.2$^{a}$ | 1.0±0.2$^{a}$ | 0.9±0.2$^{a}$ | 0.9±0.3$^{a}$ | 0.4±0.1$^{b}$ |
| spleen weight | 0.9±0.2$^{a}$ | 0.8±0.2$^{a}$ | 0.6±0.1$^{b}$ | 0.6±0.1$^{b}$ | 0.5±0.1$^{b}$ | 0.4±0.1$^{b}$ |
| testes weight | 2.8±0.4$^{a}$ | 2.9±0.5$^{a}$ | 2.4±0.3$^{a}$ | 2.5±0.6$^{a}$ | 1.9±0.6$^{b}$ | 1.5±0.6$^{b}$ |
| brain weight | 1.6±0.1$^{a}$ | 1.6±0.2$^{a}$ | 1.7±0.1$^{b}$ | 1.6±0.2$^{a}$ | 1.6±0.1$^{a}$ | 1.5±0.1$^{a}$ |

Values in horizontal columns sharing different superscripts are significantly different ($p < 0.05$).

Concentrations of hepatic fat, total cholesterol, free cholesterol, and total saturated fatty acids (TSFA), total monounsaturated fatty acids (TMUFA), total polyunsaturated fatty acids (TPUFA), total saturated free fatty acids (TSFFA), total monounsaturated free fatty acids (TMUFFA) and total polyunsaturated free fatty acids (TPUFFA), triglycerides saturated fatty acids (TrSFA), triglycerides monounsaturated fatty acids (TrMUFA), and triglycerides polyunsaturated fatty acids (TrPUFA) are given in table 4. Isocaloric substitution of starch by HEAR oil decreased levels of total cholesterol, (TMUFA), and increased the level of TSFA. Increased levels of TMUFFA and TPUFFA of rats consumed diet VI verified their exhaustion. Its interesting that further substitution of HEAR oil decreased and than increased levels of TSFA, TSFFA and TMUFFA. It may be explained by the presence of pectin.

Table 3. Serum lipids and protein

| Measurement | Diets | | | | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| total lipids (g/l) | 2.48±0.52[a] | 2.36±0.47[a] | 2.83±0.83[a] | 3.50±1.71[b] | 4.05±0.77[b] | 3.43±0.77[b] |
| triglycerides (g/l) | 0.42±0.19[a] | 0.43±0.20[a] | 0.87±0.19[b] | 0.99±0.22[b] | 1.05±0.37[b] | 0.81±0.28 |
| free fatty acids (mmol/l) | 0.57±0.04[b] | 0.58±0.05[b] | 0.51±0.06[a] | 0.53±0.07[a] | 0.48±0.06[a] | 0.58±0.03[b] |
| total cholesterol (g/l) | 0.69±0.10[b] | 0.57±0.11[b] | 0.98±0.16[a] | 0.89±0.58[a] | 0.93±0.15[a] | 0.92±0.15[b] |
| free cholesterol (g/l) | 0.28±0.12 | 0.17±0.08 | 0.25±0.06 | 0,18±0.09 | 0.34±0.20 | 0.27±0.10 |
| protein (g/l) | 64.14±2.27[b] | 65.33±4.72[b] | 66.12±5.00[b] | 66.7±3.40[b] | 63.37±4.10[b] | 59.00±3.74[a] |
| albumin (g/l) | 25.22±2.62 | 25.97±1.67 | 24.57±3.78 | 26.40±2.98 | 21.95±2.88 | 23.40±3.04 |
| $\alpha_1$-albumin (g/l) | 10.9±2.52[a] | 10.28±1.45[a] | 12.72±1.45[a] | 10.29±1.23[a] | 10.94±2.22[a] | 7.76±0.96[b] |
| $\alpha_2$-albumin (g/l) | 4.19±1.24 | 4.56±0.80 | 4.46±0.51 | 4.30±1.49 | 4.88±1.18 | 4.63±0.44 |
| $\beta$-globulin (g/l) | 11.86±2.58 | 11.99±1.68 | 12.24±1.53 | 12.09±0.87 | 13.27±2.10 | 10.10±1.40 |
| $\gamma$-globulin (g/l) | 11.90±1.46 | 12.54±2.17 | 12.14±1.93 | 13.82±1.77 | 12.35±1.72 | 13.10±0.54 |
| ratio albumin to globulin | 66.37±11.13 | 66.44±6.78 | 60.77±15.54 | 66.13±11.55 | 53.53±10.36 | 65.94±9.20 |

Values in horizontal columns sharing different superscripts are significantly different; ($p < 0.05$)

## CONCLUSIONS

The results of this study indicated that the presence of HMP in diets with increasing level of HEAR oil can suppress the disadvantageous effect of erucic acid on body weight, some internal organs and on the levels of protein and lipids accordingly to the amount of calories supplied with HEAR oil.

Table 4. Concentrations of hepatic fat (g/100 g), cholesterol and fatty acid (mg/100 g)

| Measurement | diets | | | | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| hepatic fat | 3.51±0.39 | 3.00±0.67 | 2.99±0.39 | 3.56±0.40 | 3.36±0.40 | 3.25±0.68 |
| total cholesterol | 85.78±20.07$^{a}$ | 68.74±16.28$^{a}$ | 220.64±41.85$^{b}$ | 224.45±69.28$^{b}$ | 220.80±82.47$^{b}$ | 225.60±80.33 |
| free cholesterol | 41.77±4.04 | 36.37±9.09 | 41.63±10.97 | 48.28±9.69 | 42.42±15.43 | 41.15±6.12 |
| TSFA | 1372±125$^{c}$ | 1096±266$^{b}$ | 996±266$^{b}$ | 1074±281$^{b}$ | 915±103$^{a}$ | 746±66$^{a}$ |
| TMUFA | 339±108$^{a}$ | 293±22$^{a}$ | 362±32$^{a}$ | 429±99$^{b}$ | 383±118$^{b}$ | 411±70$^{b}$ |
| TPUFA | 1033±211 | 916±134 | 865±242 | 908±97 | 855±97 | 826±108 |
| TSFFA | 28.00±6.48$^{b}$ | 24.25±4.3$^{b}$ | 17.50±2.51$^{a}$ | 14.2±1.2$^{a}$ | 21.2±4.8$^{b}$ | 26.2±6.6$^{b}$ |
| TMUFFA | 10.0±1.88$^{b}$ | 7.28±1.5$^{b}$ | 5.78±2.0$^{a}$ | 3.0±0.0$^{a}$ | 6.2±2.3$^{a}$ | 8.5±2.3$^{b}$ |
| TPUFFA | 11.7±3.3$^{a}$ | 9.75±1.7$^{a}$ | 7.2±2.0$^{a}$ | 9.2±1.8$^{a}$ | 11.0±4.2$^{a}$ | 16.0±4.54$^{b}$ |
| TrSFA | 295.0±3.69$^{b}$ | 330.0±38.2$^{b}$ | 185.0±26.4$^{a}$ | 200.0±24.4$^{a}$ | 127.5±22.1$^{a}$ | 130.0±29.4$^{a}$ |
| TrMUFA | 302.7±61.3 | 274.7±22.1 | 302.5±9.0 | 367.5±53.7 | 297.5±5.5 | 300.0±121.1 |
| TrPUFA | 205.0±78.5 | 85.0±41.2 | 97.5±49.9 | 132.5±17.0 | 97.5±49.9 | 127.5±61.3 |

Values in horizontal columns sharing different superscripts are significantly different; ($p$ 0.05)

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