EFFECTS OF LOW METHOXYL PECTIN, HIGH METHOXYL PECTIN, AGAR, AND RAPESEED OIL ON GROWTH, LIPIDS, PROTEIN, SODIUM, POTASSIUM, AND CHLORIDES IN THE RATS

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INTRODUCTION

It has been well documented that diets containing rapeseed oils rich in erucic acid (HEAR oil) depressed growth rate, lowered digestibility, effected reproduction and adrenals, testes, ovaries, liver, spleen, kidneys, blood, heart, and skeleton (Borg 1975, Ziemlański 1977, Kramer et al 1983). There is also a significant literature on the influence of pectin and agar on the metabolism and circulating levels of lipids and proteins (Spiller et al 1980, Seyring et al 1983, Vahouny and Kritchevsky 1986). Information about interaction of pectin and agar with HEAR oil is lacking.

The present study was undertaken to assess the relative effects of adding of low methoxyl pectin (LMP), high methoxyl pectin (HMP) and agar to diets containing HEAR oil. The parameters which were determined included weight gains, the weights of individual organs, levels of blood triglycerides, cholesterol, protein, hemoglobin, sodium, potassium, chlorides, specific plasma protein components and the concentration of hepatic fat and hepatic fatty acid composition.

MATERIALS AND METHODS

Male Wistar rats weighing 55g were randomly divided into four groups of eight animals and housed in quaters main - tained at 21°C. Animals were provided with one of foru different diets and with water ad libitum for 60 days. The composition of the diets is shown in Table 1.

Tats were weighed every 10 days. Animals were fasted for 24 h prior to collection of blood by heart puncture (under ether anesthesia). The liver, kidneys, heart, spleen and testes were removed

Table 1. Composition of Test Diets (g/1000g)

Component	Diets			
	LMP	HMP	Agar	Control
Casein	150	150	150	150
HEAR oil	140	140	140	140
Wheat Starch	564	564	564	660
LMP	96	-	-	-
HMP	-	96	-	-
Agar	-	-	96	-
Vitamin Mix	10	10	10	10
Salt Mix	40	40	40	40

and weighed. Blood was analysed for fasting levels of triglycerides (Chromy et al 1979), cholesterol , total protein, hemoglobin, major protein fractions, sodium, potassium, and chloride (Tomaszewski 1970). Liver was homogenised in 20 volumes of chloroform methanol according to Folch et al (1957). The lipid extracts were analysed for total fat and for total free fatty acids (Kates 1972). 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. No relevent differences either in the final body weight or in tne increase of weight gain were stated. However the average increase in weigt of the rats fed diets inculding LMP, HMP and agar was 15% lower than of the rats on the control diets. This observation proves the importance of the prior data concerning the ability of the dietary fibre (DF) to decrease the animals body weight (Spiller et al 1980, Vahouny and Kritchevsky 1986).

The diets used in the study influenced considerably the weight of kidney, heart and testes. The addition of LMP decreased the kidney weight, whereas the addition of HMP reduced also the weight of heart. Agar added to the diet caused the raise in the testes weight.

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

Parameters	LMP	HMP	Agar	Control
	LMP	HMP	Agar	Control
Initial body weight	54.2± 3.6	54.6± 3.5	56.8± 4.4	56.5± 4.2
Final body weight	194.3±33.8	194.4±21.9	194.8±22.3	220.9±24.3
Body weight gain	140.1±31.3	139.8±17.5	138.0±21.2	164.4±21.5
Liver weight	6.76±0.94	6.38±0.82	6.21±0.87	7.09±0.81
Kidney weight	1.40 ± 0.23^{a}	1.40 ± 1.16^{b}	1.59±0.10	1.75 ± 0.25^{ab}
Heart weight	0.76±0.14	0.70 ± 0.11^{a}	0.78±0.09	0.87 ± 0.11^{a}
Spleen weight	0.49±0.11	0.57±0.14	0.46±0.06	0.44±0.07
Testes weight	1.31 ± 0.28^{b}	1.76 ± 0.38^{abc}	1.36 ± 0.32^{ad}	1.01 ± 0.22^{cd}

Values in horizontal rows which bear the same superscript are significantly different. p 0.05.

Table 3. Serum lipids, protein, sodium, potassium and chlorides

Parameters	Diets			
	LMP	HMP	Agar	Control
triglycerides (g/l)	0.92±0.20	0.90±0.22	0.97±0.25	1.02±0.27
choresterol (g/l)	0.73±0.10	0.70 ± 0.10^{a}	0.76±0.12	0.81 ± 0.07^{a}
protein (g/l)	68.38 ± 3.67^{a}	67.06 ± 2.76^{b}	71.31 ± 7.00^{c}	76.10 ± 5.63^{abc}
homoglobin (g/l)	142.77 ± 43.00^{bd}	113.20 ± 22.41^{ac}	187.94 ± 41.48^{cd}	208.21 ± 14.24^{ab}
albumin (g/l)	16.74 ± 1.94^{abc}	21.14 ± 2.52^{c}	21.82 ± 2.99^{a}	23.92 ± 4.00^{b}
α_1-globulin (g/l)	12.41±1,45	12.99±1.36	14.77±2.25	14.67±2.72
α_2-globulin (g/l)	7.99 ± 2.31^{b}	6.54 ± 1.14^{c}	17.04 ± 3.53^{abc}	8.79±2.02
β-globulin (g/l)	12.62±1.94	12.59±1.51	11.65±4.47	15.02±4.02
γ-globulin (g/l)	18.07 ± 2.79^{bd}	13.78 ± 2.73^{cd}	6.01 ± 1.23^{abc}	14.81 ± 4.72^{a}
sodium (mmol/l)	187.50 ± 20.75^{bd}	182.00 ± 13.12^{ac}	152.50 ± 6.44^{ab}	158.33 ± 9.20^{cd}
potassium (mmol/l)	5.65±1.09	$6.84\pm.26^{ab}$	4.98 ± 0.44^{a}	$5.38\pm1,09^{b}$
chlorides (mmol/l)	147.80 ± 26.46^{ab}	131.20±16.77	110.33 ± 6.77^{b}	115.50 ± 17.51^{a}

Values in horizontal rows which bear the same superscript are significantly different. p 0.05.

Concentrations of circulating lipids, protein, protein fractions, sodium, potassium and chlorides are summarized in Table 3. The addition of LMP, HMP, and agar lowered the protein level what can be explained by the influence of DF on protein digestion and absorption (Spiller et al 1980, Vahouny and Kritchevsky 1986). However, the considerable decrease in the level of hemoglobin was brought about by the LMP and HMP diets. Both types of pectins reduced also the level of sodium. This can be explained in terms of the lower efficiency of agar in iron and potassium bonding. Other interactions, however, cannot be excluded (Spiller et al 1980, Vahouny and Kritchevsky 1986). LMP caused the reduction of the level of albumin and chlorides, while HMP lowered the level of potassium and chlorides. However, agar increased the level of α_2- globulin and γ - globulin. The addition of DF applied here did not influence the level of triglycerides, κ - globulin and β- globulin.

Tbale 4. Concentration of hepatic fat g/100g and hepatic fatty acid composition mg/100 g

Fatty acid	Diets			
	LMP	HMP	Agar	Control
Fat	3.18±0.30	3.47±0.36	3.22±.28	3.11±0.40
16 : 0	421.83±36.57	442.27±26.02	450.47±34.76	428.19±33.37
18 : 0	254.16±20.23	275.30±35.88	259.85±33.95	244.53±35.88
18 : 1	121.32±33.71	133.99±34.57	110.87±14.13	93.64±22.54
18 : 2	156.25±20.44	168.21±25.37	166.14±21.19	171.15±33.30
18 : 3	7.16±1.65	6.16±2.01	7.50±1.64	6.30±1.05
20 : 0	0.85±0.25	1.07±0,41	0.62±0.12	0.63±0.19
20 : 1	30.13±8.97	29.61±8.65	26.45±7.33	24.16±5.94
20 : 2	4.06±1.27	3.59±1.41	3.06±0.90	3.19±1.00
20 : 4	349.51±36.85	359.65±45.32	341.58±36.06	325.46±42.69
22 : 1	18.2±3.2	19.42±5.39	15.97±5.52	15.48±4.32
nonidentified	225.14±47.00	221.90±45.10	215.78±56.43	189.83±52.65

Values in horizontal rows which bear the same superscript are significantly different. $p < 0.05$.

Concentrations of hepatic fat and hepatic fatty acid composition are summarized in Table 4. The addition of LMP, HMP and agar did not cause any changes either in concentration of hepatic fat or in fatty acid composition.

CONCLUSIONS

Diets with LMP, HMP and agar decreased level of protein and hemoglobin, increased weight of testes and showed tendency in depressing body weight, weight gains. These diets did not alter concentration of hepatic fat and hepatic total fatty acid composition.

HMP decreased level of cholesterol and increased level of sodium and potassium. LMP increased level of sodium and chlorides.

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