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Plasma lipids of golden Syrian hamsters fed dietary rose hip, sunflower, olive and coconut oils

I. González[1], M. Escobar[2] and P. Olivera[3]

Departamento de Fisiología[1, 3], Facultad de Ciencias y Escuela de Química y Farmacia[2], Facultad de Medicina, Universidad de Valparaíso, Valparaíso (Chile)

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Plasma lipids of male golden Syrian hamsters fed diets supplemented with 15 % (w/w) rose hip, sunflower, olive, or coconut oils during four weeks were assessed. The results confirm the saturated fat hyperlipidemic effect on golden Syrian hamsters fed with the olive oil and coconut oil, reaching the highest triglyceride levels. The monounsaturated (olive oil) or polyunsaturated (rose hip and sunflower oils) fatty acid-rich-vegetable oils have a similar action on the HDL-cholesterol. No statistically significant difference was observed for total cholesterol, HDL-cholesterol and triglyceride plasma levels in the rose hip and sunflower groups, showing that the polyunsaturation degree of both oils does not affect those results. Compared with the plasma levels obtained in the olive and coconut oil groups, rose hip and sunflower oils present a marked hypolipidemic effect, which could be due to a specific action of the series n-6 linoleic acid.

Key Words: Plasma lipids, Hamster, Rose hip oil, Sunflower oil, Olive oil, Coconut oil.

Dietary fat appears to be a potent modulator of plasma cholesterol; high plasma cholesterol levels, mainly low-density-lipoprotein (LDL) cholesterol, are a widely recognized major risk factor for coronary heart disease (CHD) whereas high levels of high-density-lipoprotein (HDL) cholesterol are considered a negative risk factor for CHD (1, 3, 13). Saturated fat-enriched diets show a hypercholesterolemic effect in human and animal species; in contrast, polyunsaturated and monounsaturated-enriched diets reduce plasma cholesterol levels (13, 15). Although the mechanism(s) responsible for this effect remain poorly understood, the change in plasma cholesterol levels that can be achieved is dependent upon

Correspondence to I. González (Telf.: 32-281953; Fax: 56-32-281949).

the ratio of polyunsaturated to saturated fatty acids in the diet (14).

Epidemiological studies showed that death rates due to CHD were relatively low in Mediterranean countries. Their traditional diet provided a combination of a low saturated fatty acid content and a high total fat intake (40 % of total energy) due basically to a high consumption of olive oil rich in monounsaturated fatty acid; this low incidence of CHD could be related to the potentially beneficial effects on the lipoprotein profile of diets high in monounsaturated fatty acids (1, 11).

Previously we have examined the effects of two different polyunsaturated vegetable oils, rose hip seed oil *(Rosa moschata* Mill) and corn oil with a polyunsaturated/saturated ratio (P/S index) of 15.8 and 6.1 respectively on the plasma lipid pattern in rats. In spite of the greater P/S index of rose hip oil, both rose hip oil and corn oil exerted similar effects on plasma lipids (10).

The purpose of this study was to evaluate the plasma lipid pattern in another biological model, the golden Syrian hamster fed with either rose hip oil or sunflower oil, both rich in polyunsaturated fatty acid, although with a very different P/S index and to compare these results with those induced by the intake of olive or coconut oils.

Materials and Methods

Thirty-day-old male golden Syrian hamster (*Mesocricetus auratus*), weighing 71.5 ± 5.6 g were used in this study. The animals were placed in individual cages kept under controlled temperature and humidity conditions, and exposed to a 12 hour light/dark cycle.

The hamsters were divided into four groups and were fed a semipurified diet containing either 15 % (w/w) rose hip, sunflower, olive or coconut oils for 4 weeks. The composition of the experimental diets is given in table I. The fatty acid methylesters of experimental oils were determined by gas liquid chromatography (table II). The animals had free access to food and water. The food intake was recorded every two days and the body weight of each hamster was measured weekly. After 28 days on the diet, hamsters (n = 6 or 7 per group) on a 14 hours fast were anaesthetized with ether, and their blood was collected in heparinized glass tubes. At the same time, their livers were excised and weighed. Plasma lipid concentrations were quantitated by enzymatic colorimetric methods using commercially available enzymatic kits. Total cholesterol was assayed with Merckotest 14366 (Merck, Darmstadt). Plasma HDL-cholesterol was separated from other lipoprotein fractions by precipitation and centrifugation (Merckotest 14210) and was quantitated by Merckotest 14366. Plasma triglycerides were determined by Test combination Triglycerides GPO-PAP 701882 (Bôehringer Mannheim GmbH).

Statistical analysis.- The numerical data are expressed as a mean value ± standard deviation. A one way analysis of variance

Table I. *Composition of experimental diets.* Oils used were: rose hip, sunflower, olive or coconut.

Ingredient	g / 100 g
Casein	20.0
DL-Metionine	0.3
Mineral mixture[1]	4.0
Vitamin mixture[1]	1.0
Potato starch	5.0
Corn starch	20.0
Sucrose	34.7
Vegetable oil	15.0

[1]AIN-76 (American Institute of Nutrition).

Table II. *Fatty acid composition of rose hip, sunflower, olive and coconut oils.*
Results are expressed as the percentages of total fatty acid methyl esters. P/S = Polyunsaturated index.

Fatty acid	Rose hip	Sunflower	Olive	Coconut
Saturated				
Caproic				3.2
Caprilic				3.7
Capric				4.6
Lauric				45.5
Myristic				18.9
Palmitic	4.1	5.6	12.4	9.9
Estearic				3.3
Monounsaturated				
Palmitoleic			1.6	
Oleic	23.6	36.0	69.8	8.5
Erucic		2.9		
Polyunsaturated				
Linoleic	40.6	49.1	13.8	2.7
Linolenic	31.7	2.3	1.7	
P/S	17.63	9.20	1.25	0.03

(ANOVA) was performed and a probability value (P) of 0.05 or less was considered to be significant (Newman-Keuls test).

Results and Discussion

The male golden Syrian hamster has become a good model among animal species to study lipid and lipoprotein metabolism; it has been identified as the rodent species with the lipoprotein metabolism most closely related to that of man, increasing the interest in this animal for comparative studies on cholesterol metabolism (2, 7, 13). In addition, hamsters, like man, respond to cholesterol-lowering agents, by changing their plasma LDL concentration and their level of hepatic LDL-receptors (6). Based on these prior studies, we used this model to evaluate the plasma lipid pattern with either rose hip oil or sunflower oil intake, both rich in polyunsaturated fatty acids, although with a very different P/S index, and to compare these results with those induced by the intake of olive oil or coconut oil in golden Syrian hamsters.

The P/S index for the rose hip, sunflower, olive and coconut oils were 17.63, 9.20, 1.25 and 0.03, respectively. The major fatty acids quantified in these oils were: linoleic and linolenic in rose hip oil, linoleic and oleic in sunflower oil, oleic in olive oil and lauric in coconut oil (table II).

Body weights and body weight gain of animals after feeding on experimental diets for 4 weeks are given in table III. Animals remained healthy throughout the experiment and they all had similar weight at the end of the dietary treatment period (n.s). There was no significant difference in total food intake and liver weight, in spite of a slight increase in liver weight in the groups fed with coconut and rose hip oils.

Table III. *Body weight, weight gain, total food intake, liver weight and relative liver weight of hamsters fed with the experimental diets for 28 days.*
Values are means ± SD (n = 6 or 7).

	Rose hip (7)	Sunflower (7)	Olive (6)	Coconut (6)
Initial body weight (g)	71.86 ± 5.89	70.71 ± 5.79	70.83 ± 5.98	74.50 ± 2.26
Weight gain (g)	52.29 ± 6.82	58.14 ± 12.38	57.17 ± 19.46	55.33 ± 8.07
Total food intake (g)	302.23 ± 48.33	283.79 ± 33.69	289.02 ± 33.81	322.41 ± 52.81
Liver weight (g)	6.46 ± 0.95	5.79 ± 0.84	5.85 ± 1.11	6.33 ± 1.16
Relative liver weight (%)	5.07 ± 0.70	4.54 ± 0.34	4.56 ± 0.23	4.85 ± 0.58

Table IV. *Plasma lipid concentration (mg/dL) in hamsters fed the experimental diets for 28 days.*
Values are means ± SD (n = 6 or 7). For each value, equal letters mean no significant differences.

Dietary fat type (15 %)		Cholesterol		
		Total	HDL	Triglycerides
Rose hip	(7)	97.94 ± 12.98[a]	67.90 ± 9.66[a]	104.55 ± 19.41[a]
Sunflower	(7)	102.62 ± 6.70[a]	71.07 ± 10.08[a]	113.13 ± 31.38[a]
Olive	(6)	140.75 ± 28.64[b]	89.50 ± 22.05[a]	188.35 ± 40.63[b]
Coconut	(6)	204.89 ± 31.35[c]	136.35 ± 33.63[b]	170.62 ± 63.73[b]

Plasma lipid concentrations of hamsters fed the experimental diet for 4 weeks were significantly altered by the type of dietary fat (table IV). The substitution of polyunsaturated fat for saturated triglycerides in the diet results in a reduction in plasma cholesterol levels (14). It is interesting to note that no significant differences in any of the lipid studied were found between rose hip and sunflower groups. The rose hip oil, rich in linoleic and linolenic acid, and sunflower oil, rich in linoleic and oleic acid, are oils with a very different P/S index, however, their effects were very similar. These results suggest that linoleic acid-rich vegetable oils with different polyunsaturation index, lower indistinctly the total and LDL cholesterol, which might be due to the linoleic acid capacity to induce a greater hepatic LDL receptor activity and to elevate LDL receptor numbers (8, 9, 13). Polyunsaturated fatty acids might induce a greater LDL receptor activity due to modification of cholesterol homeostasis, variation of the physical properties of hepatocyte membranes, changes in the lipoprotein composition, lipoprotein size (4, 15), as well as variation of the hepatic acyl-CoA cholesterol acyltransferase (ACAT) activity (5). The combination of a marked increase in the uptake of cholesterol via hepatic LDL receptors and the unaffected hepatic cholesterol 7α-hydroxylase activity induced by linoleic acid may cause supersaturation of bile with cholesterol and contribute to the formation of cholesterol gallstone (9).

HDL-cholesterol level of olive group reached statistically similar values to the rose hip and sunflower groups. In fact, olive oil is as effective as polyunsaturated fatty acid enriched vegetable oils in reducing serum cholesterol levels without interfering with HDL metabolism (1, 9, 12). In addition, dietary oleic acid may prevent the supersaturation of bile with cholesterol by increasing hepatic cholesterol

7α-hydroxylase activity despite the moderate increase in uptake of cholesterol via hepatic LDL receptors (9).

The hamsters fed with the coconut oil, rich in saturated fatty acids, reached the highest levels of all measured plasma lipids. The rise in plasma levels of cholesterol, triglycerides, LDL-cholesterol and Apo B-100 in hamsters fed coconut supplementation diet has been reported (7, 16). Highly saturated fatty acid diet can significantly decrease the binding affinity of LDL to liver plasma membranes (15), decrease the expressed number of hepatocyte LDL receptors (13), increase the production rate and decrease the fractional catabolic rate of HDL (7), leading to an increase in plasma cholesterol concentration (14).

In summary, rose hip oil and sunflower oil produced a hypocholesterolemic and hypotriglycidemic effects on hamsters. The similar hypolipidemic effect of both oils could be partly due to the specific action of the series n-6 linoleic acid. Further investigation is required to delineate the precise mechanism(s) responsible for this effect.

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I. GONZÁLEZ, M. ESCOBAR y P. OLIVERA. *Niveles lipídicos plasmáticos en hámster dorado alimentado con aceite de rosa mosqueta, girasol, oliva o coco.* J. Physiol. Biochem. (Rev. esp. Fisiol.), 53 (2), 199-204, 1997.

Se evalúan los niveles de lípidos plasmáticos de hámsters macho dorado alimentados con dieta suplementada con 15 % (p/p) de aceite de rosa mosqueta, girasol, oliva o coco, durante 4 semanas. Los resultados confirman el efecto hiperlipidémico de las grasas saturadas, alcanzando los triglicéridos los niveles más altos en los grupos oliva y coco. Los aceites vegetales ricos en ácidos grasos monoinsaturados (oliva) o poliinsaturados (rosa mosqueta y girasol) tienen acciones similares sobre las HDL-colesterol. Las concentraciones plasmáticas de colestero total, HDL-colesterol y triglicéridos de los grupos rosa mosqueta y girasol no presentan diferencias estadísticamente significativas, sugiriendo que el grado de poliinsaturación de estos aceites no altera los niveles plasmáticos de los lípidos evaluados. Al comparar estos valores con los obtenidos en los grupos oliva y coco destaca el efecto hipolipidémico de los aceites rosa mosqueta y girasol, pudiendo deberse este efecto a la acción específica del ácido linoleico de la serie n-6.

Palabras clave: Lípidos plasmáticos, Hámster dorado, Aceite de rosa mosqueta, Aceite de girasol, Aceite de oliva, Aceite de coco.

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