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IMPROVE OF LIPID METABOLISM AND CALCIUM ABSORPTION IN HYPERCHOLESTEROLEMIC RATS BY USE OF POTATO PEEL (LOW CALORIE) AND WHEAT BRAN BREADS

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ABSTRACT

Improve lipid metabolism and absorption of calcium and magnesium in cholesterol-fed rat were studied. To accomplish this aim potato peel and wheat bran breads were investigated. Thus 4 groups of 8 rats each were used. The first group was fed on basal diet (control). The other groups fed on basal diet +1 % cholesterol. Potato peel bread (PP-bread) (10 % of diet) was added in 3rd group, while wheat bran bread (WB-bread) (10 % of diet) was used in 4th group. An increase of short chain fatty acids (SCFA) was observed in content in the feces of rats that consumed either of the two different kind of bread. Potato peel bread diet increased the acetate, propionate and butyrate concentrations compared to wheat fiber group. Consequently, both absolute apparent Ca absorptions (mg/d) and relative (%)were affected by both treatments, and those were greater (51 ± 2.4 and 71.5 ±1.68) by PP-bread diet than that of WB-bread diet (45 ±2.1 and 62 ±3.8). Relative apparent Mg absorptions were higher after ingestion of PP-bread diet as compared to those that fed on WB-bread diet. The plasma lipoprotein shows a reduction of LDL (-66.6% and -61.1) in rats fed on PP-bread and WB-bread diets, respectively compared to hypercholesterolemic group. The presence of potato and wheat fiber in the diet increased HDL level (10.8 % and 7.8 %, respectively) compared to hypercholesterolemic group. Triglyceride and LDL concentrations were significantly lower in rats fed with potato fiber-enriched diet as compared to those that fed on wheat fiber diet (68.4 ± 4.51 % vs. 74.4 ± 6.41 % and 36.7 % ±4.52 vs. 42.8 % ±10.36, respectively).

INTRODUCTION

Waste materials from a wide range of agro-industrial processes may be used as the substrates for microbial growth, thereby resulting in upgrading of the waste or the synthesis of valuable by-products. Much of the waste resulting from industrial peeling and trimming of foods is similar to the waste generated in household kitchens. In addition to these wastes, in the developing world, large quantities of fruit and vegetables are wasted seasonally when production exceeds demand, particularly when coupled with a lack of proper transportation and preservation processes [Mahmood *et al.*, 1998].

Potato is one of the vegetables rich in vitamin C and is also an interesting source of dietary fiber (7% of peeled potato, up to 11% of non-peeled potato). Potato fibers are mainly water-soluble fibers (55%) such as hemicelluloses and pectins (shown to have hypocholesterolemic effects on rats [Anderson, Bridges, 1988], together with water insoluble fibers (45%) such as cellulose [Anderson, Bridges, 1988 and Remesy *et al.*, 1992].

Potato peel apparently is superior to wheat bran in the contents of certain minerals, in total dietary fiber, in water-holding capacity, in its lower quantity of starchy components, and in its lack of phytate (Toma *et al.*, 1979).

Hypercholesterolemia is an established major risk factor for coronary artery disease. Lifestyle modification is the preferable form of treatment for most types of hyperlipidemia (National Cholesterol Education Program, 1993). The most potent drugs that are currently used to lower elevated (LDL-C) levels are the 3-hydroxy–3-methylglutaryl-coenzyme A (HMG-CoA) reductase inhibitors (statins) (Gould *et al.*, 1995 and Law *et al.*, 2003). Because of patient reluctance to be treated with chemically derived drugs, especially for primary prevention which may contribute to the above discrepancy, there is a need for effective, safe and ideally naturally derived drugs.

However, more studies suggest that a low bioavailability of calcium is one of the risk factors associated with the development of the disease and osteoporosis (Heaney, 1985).

The potential beneficial effects of fermentable carbohydrates and fiber on mineral absorption and status, in particular Ca and Mg, have been largely investigated workers (Delzenne *et al.*, 1995, Lopez *et al.*, 1998 and Coudray *et al.*, 2003).

Present studies have been aimed primarily at the use of peelings removed from potatoes (Solanum tuberosum) for the production of bread (50 % of potato peel) of use in the food with the resultant protection of hypercholesterolemia and effect it on mineral absorption (Ca and Mg,) compared to wheat bread (50 % wheat bran) in rats.

MATERIALS AND METHODS

Preparation of Potato Peel Powder

Fresh potato peels (PPs), obtained from a local potato chips manufactory (6th october City), were washed three times with tap water and then dried at 70 ◦C overnight in a 'cross flow drier.' The dried peel was ground in a multimill and passed through a 0.5mm mesh sieve to obtain a fine powder. The final PP-powder was used in bread product preparation.

Preparation of high fiber Bread

Fifty % of potato peel or wheat bran level were used in bread preparation. The bread dough was made from commercially available wheat flour (72 %), potato peel or wheat bran, yeast and water. The dough was left to leaven at room temperature for 2 h. A loaf was then baked for 12 min at 225°.

Experimental animals

Basal diet was provided in accordance with AIN-93M formulation (Reeves *et al.* 1993), as shown in Table (1). The experiments were conducted on 32 male albino rats weighing 80g ± 1.0. The rats were housed in individual stainless steel cages. The rats were fed on basal diet for one week as adaptation, water was available ad-libitum. The rats were divided into 4 groups, each of 8 rats. The first group was fed on basal diet

(control) .The second group was fed on basal diet +1 % cholesterol. The third group was fed on basal diet +1 % cholesterol+ potato peel bread (10 % of diet), while the group 4 was fed on basal diet +1 % cholesterol+ wheat bran bread (10 % of diet). After 6 weeks the animals were fasted overnight, blood samples were withdrawn by a fine capillary glass tube from the orbital plexus vein. The blood was collected in heparin containing tubes and which were centrifuged at 3000 rpm for 15 min. and stored at –20°C until analysis.

Table (1): Composition of the diets provided during the study (g/kg diet)[Reeves *et al.*, 1993].

Groups	Group (1) Control	Group (2) Control (+)	Group (3) PP-bread	Group (4) WB-bread
Casein	140	140	140	140
Sucrose	100	100	100	100
Salt mixture	35	35	35	35
Vitamin mix	10	10	10	10
Corn oil	40	40	40	40
Cellulose	50	50	0	0
Cholesterol	0	10	10	10
bread	0	0	100	100
Starch	625	615	565	565
Total	1000	1000	1000	1000

Analytical methods. Food intake was monitored by collection of duplicate meals. About 0.5 g of tested products or diets and 0.25 g of feces were dry-ashed at 500°C for 10 h, then the dry residue was added to HCl.(6 M), diluted adequately and analyzed for Ca and Mg [Pallout *et al.*, 1994]. Calcium and magnesium were assayed by Varian Model Spectra AA220 flame atomic absorption spectrometry with an air-acetylene flame and hollow cathode lamps at wavelengths 422 and 285 nm, respectively (Varian Australia Pty., Ltd., Mulgrave, Vic. 3171, Australia). Mineral levels were calculated from standard curves of mineral solutions (Merck). Analytical quality was checked using total diet control standards for dietary mineral measurements. All measurements were performed at least in duplicate. Fecal short-chain fatty acid (SCFA) levels were determined by gas-liquid chromatography [Lombard, Dowell, 1982].

Total cholesterol was determined using enzymatic method of Allain *et al.* (1974). The triglycerides were estimated according to the method of McGowan *et al.* (1983). HDL-C and LDL-C were determined according to the method of Wieland and Seidel (1983).

Calculations of absolute apparent absorption

Absolute apparent absorption (mg/d) was calculated as follows:

(daily mineral intake - daily mineral fecal excretion).

Relative apparent absorption (%) was calculated as follows:

100 x [(daily mineral intake - daily mineral fecal excretion)/(daily mineral intake)].

Statistical analysis :

The results were expressed as mean ±SD. Statistical significance was calculated using student's t test according to the method of Statgraphics Program Statistical Graphic System Version 2.6 (1987). Differences were considered statistically significant if the p value < 0.05.

RESULTS AND DISCUSSION

Dietary fiber could affect lipid metabolism and calcium balance in hypercholesterolemic rat. So potato peel and wheat bran breads supplemented with 1% cholesterol were investigated. It was found that no differences in the daily food intake between all groups (14-15 g dry matter/d). The weight gain was significantly low in rats fed dietary fiber compared to those fed control diet in group 2 ($p<0.01$). The dietary fiber did not affect the relative weight of the organs (Table, 2).

Table (2): Initial, terminal body weights (g) and relative organs weight (%) among different treatment groups.

Group	Group (1) control	Group (2) Control +	Group (3) PP	Group (4) B
	Mean ± SE			
Initial weight (g)	100.18± 6.75	94.5±7.3	89.79±6.1	91.05±6.9
Terminal weight(g)	171.88±11.14	170±7.57	152±6.5	153±5.05
Wight Gain(g)	71.7±9.6	75.5±6.7	62.09±6.4	61.45±5.9
Heart weight (g)	0.61±0.02	0.57±0.02	0.58±0.02	0.54±0.02
%*	0.36±0.02	0.30±0.05	0.38±0.02	0.36±0.02
Spleen weight (g)	0.67±0.033	0.65±0.04	0.71±0.07	0.6±0.03
%	0.40±0.02	0.38±0.02	0.47±0.04	0.4±0.03
Kidney weight (g)	1.02±0.04	1.04±0.50	1.02±0.03	1.00±0.03
%	0.61±0.04	0.62±0.03	0.68±0.02	0.66±0.03

*** Relative organs weight = organ weight (g)/ body weight (g) x 100**

Plasma cholesterol and triglycerides were significantly lower in rats that fed on potato and wheat fiber-enriched diet than in hypercholesterolemic rats (-39.4%, & -39.3%, and -36.7% & -31.1, respectively (Table 3). Potato peel and wheat bran bread diets reduced the plasma LDL (-66.6% and -61.1, respectively) compared to hypercholesterolemic rats. While they increased HDL (+10.8 % and 7.8 % respectively) compared to hypercholesterolemic group. Triglyceride and LDL concentrations were significantly low in rats fed on PP-bread diet as compared to those fed on wheat fiber diet (68.4 ± 4.51 % vs. 74.4 ± 6.41 % and 36.7 % ±4.52 vs. 42.8 % ±10.36 respectively)

Indeed, previous studies have reported similar effects with high fiber diets [Ullrich, 1987]; moreover, fibers are known to affect the lipoprotein profile in cholesterol-fed rats [Mazur *et al.*, 1990]. Potato peel fibers are mainly water-soluble fibers (55%) such as hemicelluloses and pectins, which showed together hypocholesterolemic effects on rats and also water insoluble fibers (45%) such as cellulose [Anderson and Bridges, 1988; Remesy *et al.* 1992]. The effect of pectin on lipid metabolism has been well studied both in

humans and animal models [Anderson and Bridges, 1988; Fernandez, 2001, and Aprikian *et al.*, 2003] and previous experiments demonstrated that dietary fibers can also exert cholesterol-lowering effects by increasing fecal excretion of total steroids (neutral sterols and bile acids) [Fernandez, 1995]. Robert (2006) observed that potato-enriched diet consumption led to a significant increase of neutral sterol fecal excretion, especially of coprostanol, and to an increase in the amount of cholesterol excreted in feces as bile acids. Present data obtained from cholesterol-fed rats support the view that fibers are effective in depressing the absorption of exogenous cholesterol, as previously shown in guinea pigs and rats [Fernandez, 1995, and Moundras *et al.*, 1997]. The mechanisms of inhibition of cholesterol absorption, in which viscosity is an important contributor, have been well documented; they include disturbance of micelle formation, slowing of cholesterol transfer to the brush border across the unstirred layer and inhibition of ileal bile acid reabsorption [Stedronsky, 1994]. It has been shown that the physicochemical properties of soluble fibers results in important modifications in volume, bulk and viscosity in the intestinal lumen, which alter metabolic pathways of hepatic cholesterol and lipoprotein metabolism, resulting in lowering of plasma LDL– cholesterol [Fernandez, 2001]. In rats fed with diets containing fibers, the intestinal bile acid pool may be increased [Moundras *et al.*, 1997]. This could reflect an entrapment of bile acids within the viscous medium, as well as an accelerated biliary influx. It is well known that when cholesterol is added to the diet, the enhanced fecal losses of bile acids correspond to a less effective reabsorption [Moundras *et al.*, 1997] and to an inhibition of the HMG-CoA reductase activity [Levrat-Verny *et al.*, 2000].

Table (3): Plasma lipid profile among different treatment groups (mg/dl).

Group	Group (1) control	Group (2) Control (+)	Group (3) PP-bread	Group (4) WB-bread
	Mean ± SE			
Total cholesterol	87.72±1.7^{a}	131.00±2.98^{b}	79.36±6.44^{a}	79.57±3.58^{a}
HDL	61.36±2.33^{a}	20.60±1.96^{a}	42.66±7.18^{a}	36.80±3.43^{a}
LDL	26.36±1.56^{a}	110.4±10.33^{b}	36.7±4.17^{ab}	42.77±6.41^{c}
TG	81.75±6.86^{a}	108±10.49^{b}	68.37±4.51^{ac}	74.4±10.36^{ac}
TC/HDL	1.43±0.04^{a}	6.6±0.64^{b}	2.1±0.30^{bc}	2.3±0.27^{ad}

a, b , c ,d same scripts in the same row indicate no significant differences (p<0.01)

Moundras *et al.*, [1997] found that rats fed on guar gum diets supplemented with cholesterol, the losses of steroids were compensated to a certain extent by the induction of liver HMG-CoA reductase. The induction of this enzyme took place in spite of an accelerated return of bile acids to the liver; this process could limit the adaptation of cholesterol synthesis and thus contribute the cholesterol-lowering effect of guar gum.

The fecal dry matter excretion was significantly low in rats fed with potato fiber-enriched diet as compared to those fed on control diet (1.93 ± 0.21 g vs. 1.57 ± 0.20 g/d, $P < 0.01$). An increase of total SCFA content in the feces of rats that consumed potato and wheat fiber-enriched diet was observed, compared to control (Table 4). The presence of potato fiber in the

diet increased the total SCFAs content, propionate and butyrate concentrations compared to wheat fiber group.

Table (4): Short chain fatty acids content in feces samples of studied groups (mmol/100 g)

Groups	Acetate	Propionate	Iso-Butyrate	Butyrate	Total SCFA
Group (1) Control	22.92^{a} ±2.11	7.33^{a} ±0.50	4.98^{a} ±0.51	3.58^{a} ±0.51	38.81^{a} ±2.2
Group (2) Control (+)	20.08^{a} ±1.91	6.70^{a} ±0.49	4.12^{a} ±0.52	3.26^{a} ±0.48	34.15^{a} ±2.3
Group (3) PP-bread	16.99^{b} ±0.5	16.89^{b} ±0.61	41.04^{b} ±2.11	7.89^{b} ±0.9	83.1^{b} ±2.6
Group (4) WB-bread	49.2^{c} ±3.11	6.1^{a} ±0.49	8.61^{b} ±1.01	3.58^{a} ±0.81	67.49^{b} ±2.1

a, b , c same scripts in the same row indicate no significant differences (p>0.05)

Fibers could also exert indirect effects on cholesterol metabolism. Their fermentation in the large intestine leads to a production of short-chain fatty acids such as propionate, which may be involved in the control of hepatic cholesterol synthesis [Chen *et al.*, 1984]. Robert (2006) observed a rise of all short chain fatty acid (SCFAs) especially of propionate (+442%) in potato fiber group. Studies on isolated hepatocytes demonstrated that propionate could inhibit cholesterol biosynthesis from acetate [Wright *et al.* 1990]. Nevertheless, the impact of propionate on cholesterol metabolism in the liver is likely less effective than the direct effect of fiber on digestive cholesterol absorption or their indirect effect on the cholesterol conversion into bile acids. All together, such mechanisms are able to decrease plasma cholesterol concentration. Potato fiber may also provide beneficial health effects by supply of antioxidant molecules. Robert (2006) investigated the defense against lipid peroxidation in the heart tissue as an important target tissue for reactive oxygen species (ROS).

Total daily Ca intake was from 72 to 75 mg for each of the 4 groups. Ca fecal excretion was similar in all three groups varied from 20 to 23 mg/d ,but Ca fecal (26 mg / d) was slightly higher in rats fed with the wheat bran enriched diet. Consequently, both absolute (mg/d) and relative (%) apparent Ca absorptions were affected by diet treatment. Absolute (mg/d) and relative (%) apparent Ca absorptions were great (51± 2.4 and 71.49 ± 1.68) after ingestion of potato peel-enriched diet as compared to those fed on wheat fiber diet (45± 2.1 and 62. ± 3.8) (Table 5). Total daily Mg intake was from 7.5 to 7.6 mg for each of the 4 experimental groups. Mg fecal excretion was higher in group 2 as compared to other groups (Table 6). Relative apparent Mg absorptions were high after ingestion of potato peel as compared to those fed on wheat fiber diet (Table 6). However, in this study, apparent Ca absorption was increased in potato peel group but it was decreased in wheat bran group. Apparent Mg absorption was unchanged in both potato peel and wheat bran groups. The potential beneficial effects of fermentable carbohydrates and fiber on mineral absorption and status, in particular Ca and Mg, have been largely investigated [Delzenne *et al.*, 1995, Lopenz *et al.*, 1998 and Coudray *et al.*, 2003]. The animal studies clearly showed a

beneficial effect of fermentable carbohydrates on intestinal absorption of Ca and Mg, although this effect is less marked for Ca than for Mg and often depends on experimental conditions. Cherbut *et al.* (1997) demonstrated that potato fibers increased the production of (SCFA). The positive effect of fermentable carbohydrates on intestinal mineral absorption is attributed mainly to the high production of SCFA [Cherbut *et al.*, 1997], which produce a decrease in the luminal pH and an increase in the concentration of ionized minerals in the cecum. Consequently, the mineral solubility is increased and the active and passive diffusion of minerals across the intestinal cells is enhanced. As a consequence, these fermentation-induced changes theoretically ought to improve the intestinal absorption of nearly all minerals in the hindgut. The intestinal absorption mechanism and site of Mg largely differ from those of Ca, which may explain the different impact of fermentable carbohydrates on the apparent absorption of these two minerals. The absorption efficiency of dietary Ca depends on two major factors: its regulation by physiological factors including hormones and its interaction with the other dietary constituents [Mathers, Dawson, 1991]. On the other hand , elements incroporated in phytate structures especially Mg, Ca, Zn and Fe [Chichlowska *et al.*1994], are hard to release and worse absorbed from digesta. Potato peel apparently is lack of phytate content compered to a wheat bran [Toma *et al.*1979]. Therefore phytic acid was more effective on the bioavailability of Ca in wheat bran group about potato peel group. Because potato fibers are mainly water-soluble fibers and is poor in phytic acid, potato peel can improve the functional properties of several food products.

Such an effect can be considered as beneficial for cardiovascular disease prevention. The cholesterol-lowering effect can be attributed to the fibers provided by potatoes peel.

Table (5): Effect of potato peel-bread and wheat bran-bread on apparent absorption of Ca.

Group	Group (1) control	Group (2) Control (+)	Group (3) PP-bread	Group (4) WB-bread
	Mean ± SE			
Ca intake g/d	0.58±0.1	0.57±0.01	0.57±0.02	0.57±0.04
Fecal calcium g/d	0.16±0.01	0.17±0.03	0.16±0.03	0.21±0.02
Ca absolute apparent absorption	0.41±0.01[a]	0.40±0.01[a]	0.41±0.01[a]	0.36±0.02[b]
Ca relative apparent absorption (%)	71.34±2.1[a]	69.49±1.5[a]	71.49±1.68[a]	62.58±3.8[b]

a, b same scripts in the same row indicate no significant differences (p>0.05)

Table (6) : Effect of potato peel-bread and wheat bran-bread on apparent absorption of Mg.

Group	Group (1) control	Group (2) Control (+)	Group (3) PP-bread	Group (4) WB-bread
	Mean ± SE			
Mg intake (g/d)	0.06 ±0.002	0.059±0.003	0.058±0.005	0.061±0.002
Fecal magnesium (g/d)	0.01±0.002	0.015±0.002	0.01±0.005	0.01±0.002
Mg absolute apparent absorption	0.05±0.003	0.045±0.001	0.05±0.01	0.05±0.005
Mg relative apparent absorption (%)	88.23±1.4	87.71±0.86	90.87±0.22	88.29±1.4

REFERENCES

Allain C.C., Poon L.S., Chan C.S.G., Richmond W. and Fu P.C., 1974. Enzymatic determination of total serum cholesterol. Clin. Chem., , 20, 470-75.

Anderson J.W. and Bridges S.R., 1988. Dietary fiber content of selected foods. Am. J. Clin. Nutr., 47, 440–447.

Aprikian O., Duclos V., Guyot S., Besson C., Manach C., Bernalier A., Morand C., Remesy C. and Demigne C., 2003. Apple pectin and a polyphenol-rich apple concentrate are more effective together than separately on cecal fermentations and plasma lipids in rats. J. Nutr., 133, 1860–1865

Chen W.J., Anderson J.W. and Jennings D., 1984. Propionate may mediate the hypocholesterolemic effects of certain soluble plant fibers in cholesterol-fed rats. Proc. Soc. Exp. Biol. Med., 1984, 175, 215–218.

Cherbut C., Aube A., Mekki N., Dubois C., Lairon D. and Barry J.L., 1997. Digestive and metabolic effect of potato and maize fibres in human subjects. Br. J. Nutr., 77, 33–46.

Chichlowska J., Szkudelski T. and Kliber A., 1994. Is phytic acid responsible for changes in thyroid hormones and insulin levels? In: *Proc Int Euro Food Toxicol* IV Conference: *Bioactive Substances in Food of Plant Origin* (Vol II), eds Kozlowska H, Fornal J & Zdunczyk Z. Centre for Agrotechnology and Veterinary Sciences, Olsztyn, Poland, pp 351-355.

Coudray C., Bellanger J., Vermore M., Sinaud S., Wils D., Feillet-Coudray C, Brandolini M., Bouteloup-Demange C. and Rayssiguier Y., 2003. Two polyol, low digestible carbohydrates improve the apparent absorption of magnesium but not of calcium in healthy young men. J. Nutr., 133, 90-93.

Delzenne N., Aertssens J., Verplaetse H., Roccaro M. and Roberfroid M., 1995. Effect of fermentable fructo-oligosaccharides on mineral, nitrogen and energy digestive balance in the rat. Life Sci., 57, 1579–1587.

Fernandez M., 1995. Distinct mechanisms of plasma LDL lowering by dietary fiber in the guinea pig: specific effects of pectin, guar gum, and psyllium. J. Lipid Res., 36, 2394–2404.

Fernandez M., 2001. Soluble fiber and nondigestible carbohydrate effects on plasma lipids and cardiovascular risk. Curr. Opin. Lipidol., 12, 35–40.

Gould A.L., Rossouw J.E., Santanello N.C., Hevse J.F. and Furberg C.D., 1995. Cholesterol reduction yields clinical benefit: a new look at old data. Circulation., 91, 2274-2282.

Heaney R.P., 1985. The role of calcium in osteoporosis. J. Nutr. Sci. Vitaminol., 31 Suppl, S21-S26.

Law M.R., Wald N.J. and Rudnicka A.R., 2003. Quantifying effect of statins on low density lipoprotein cholesterol, ischemic heart disease and stroke: systematic review and meta-analysis. BMJ., 326, 1423-1429.

Levrat-Verny M.A., Behr S., Mustad V., Remesy C. and Demigne C., 2000. Low levels of viscous hydrocolloids lower plasma cholesterol in rats primarily by impairing cholesterol absorption. J. Nutr., 130, 243–248.

Lombard G.L. and Dowell J.R., 1982. Gas-Liquid chromatography Analysis of the acid Products of Bacteria (CDC Lab Manual), US Department of Health and Human Services, Centers for Disease and Control, Atlanta, GA, USA.

Lopez W. H., Coudray C., Bellanger J., Younes H., Demigne C. and Remesy C., 1998. Intestinal fermentation lessens the inhibitory effects of phytic acid on mineral utilization in rats. J. Nutr., 128, 1192–1198.

Mahmood AU, Greenman J, Scragg AH. 1998. Orange and potato peel extracts: analysis and use as Bacillus substrates for the production of extracellular enzymes in continuous culture. Enzyme Microb Technol; 22:130– 7.

Mathers J.C. and Dawson L.D., 1991. Large bowel fermentation in rats eating processed potatoes. Br. J. Nutr., 66,313–329.

Mazur A., Remesy C., Gueux E., Levrat M.A. and Demigne C., 1990. Effects of diets rich in fermentable carbohydrates on plasma lipoprotein levels and on lipoprotein catabolism in rats. J. Nutr., 120, 1037–1045.

McGowan, M.W., Artiss, J.D., Strandbergh, D.R. and Zak, B., 1983. A peroxidase-coupled method for the colorimetric determination of serum triglycerides. Clin. Chem. 29:538-542.

Moundras C., Behr S.R., Remesy C. and Demigne C., 1997. Fecal losses of sterols and bile acids induced by feeding rats guar gum are due to greater pool size and liver bile acid secretion. J. Nutr., 127, 1068–1076.

National Cholesterol Education Program. 1993, Second Report of the Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II), National Institutes of Health Publication, 93, 3095. U.S. Government Printing Office, Washington, DC.

Pallout J., Rimbach G., Pippig S., Schindler B., Hohler D. and Most E., 1994. Dietary effect of phytognic phytase and an addition of icrobial phytase to a diet based on filed beans, wheat, peas and barley on the utilization of phosphorus, calcium, magnesium, zinc and protein in piglets. Z. Emahrungswiss., 33,128–135.

Reeves P.G., Nielsen F.H. and Fahey G.C., 1993. AIN-93 purified diets for laboratory rodents: final report of the American Institute of Nutrition ad hoc writing committee on the formulation of the AIN-76A rodent diet. J. Nutr., 123, 1939-1951.

Remesy C., Morand C., Levrat M.A., Gamet L. and Demigne C., 1992. Intérêt nutritionnel des produits végétaux riches en fibres. Cah Nutr Diét, 27, 370–377.

Robert L., Narcy A., Rock E., Demigne C., Mazur A. and Rémésy C., 2006. Entire potato consumption improves lipid metabolism and antioxidant status in cholesterol-fed rat. Eur. J. Nutr., 45 (5), 267-274.

Statgraphics. Statistical Graphics System Version 2.6. 1987. Statistical Graphic Corporation, Graphic Software System Inc., U.S. sTSC.Inc.

Stedronsky E.R., 1994. Interaction of bile acids and cholesterol with nonsystemic agents having hypocholesterolemic properties. Biochim. Biophys. Acta, 1994, 1210, 255–287.

Toma R. B., Orr P. H., D'Appolonia B., Dintzis F. R. and Tabekhia M. M., 1979. Physical and chemical properties of potato peel as a source of dietary fiber in bread . J. Food Sci., 44 (5), 1403–1407.

Ullrich I., 1987. Evaluation of a highfiber diet in hyperlipidemia: a review. J. Am. Coll. Nutr., 6, 19–25.

Wieland H. and Seidel D., 1983. A simple specific method for precipitation of low density lipoproteins. J. Lipid Res., 24, 904-909.

Wright R.S., Anderson J.W. and Bridges S.R., 1990. Propionate inhibits hepatocyte lipid synthesis. Proc. Soc. Exp. Biol. Med., 195, 26–29.

تحسين التمثيل الغذائى للدهون وإمتصاص الكالسيوم بتناول خبز قشر البطـــاطس (منخفض السعرات الحرارية) فى فئران مغذاة علي كوليسترول

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تهدف هذه الدراسة إلى تقييم نوعين مختلفين من الخبز ، الأول من قشر البطاطس والثانى من ردة القمح وذلك من حيث تحسين التمثيل الغذائى للدهون وإمتصاص الكالسيوم فى فئران تجارب تم تغذيتها على وجبة محتوية على الكوليسترول.

تم إستخدام أربع مجاميع من فئران التجارب ، كل مجموعة تحتوى على ٨ فئران. المجموعة الأولى الضابطة تم تغذيتها على وجبة متزنة أما المجموعة الثانية تم تغذيتها على وجبة متزنة تحتوى على ١% كوليسترول أما المجموعتين الثالثة و الرابعة فتم تغذيتها على وجبة متزنة تحتوى عى ١% كوليسترول تحتوى الثالثة منها على خبز ردة القمح والمجموعة الرابعة على خبز قشر البطاطس بتركيز (١٠%) لكل منهما.

وقد أظهرت الدراسة النتائج الآتي:-

١. ليس هناك اى فروق معنوية فى الأوزان الكلية او أوزان الأعضاء الداخلية (الكبد – القلب – الطحال – الرئة – الكلى) بالنسبة للوزن الكلى بين المجموعات المختلفة.
٢. زيادة فى محتوى الأحماض الدهنية قصيرة السلسلة فى براز فئران المجموعة الثالثة والرابعة والتى تناولت نوعى الخبز تحت الدراسة. حيث أن وجود قشر البطاطس فى الخبز عمل على زيادة المحتوى الكلى للأحماض الدهنية وكذلك أحماض (الأسيتات – البروبيونات والبيوتاريك) مقارنة بالمجموعة الضابطة والمجموعة المحتوية على خبز ردة القمح.
٣. تأثرت نسبة الإمتصاص الظاهرى النسبى والمطلق لعنصر الكالسيوم بنوع الخبز المستخدم فى الوجبة، حيث لوحظ أن أعلى نسبة للإمتصاص الظاهرى للكالسيوم المطلقة والنسبية ٥١% و ٧١,٥%، على التوالى كانت فى المجموعة المتناولة لخبز قشر البطاطس وذلك مقارنة بالمجموعة المتناولة لخبز ردة القمح والتى كانت نسبتها ٤٥% و ٦٢% للإمتصاص الظاهرى للكالسيوم المطلق والنسبي، على التوالى.
٤. لوحظ أن الإمتصاص انظاهرى النسبى لعنصر الماغنسيوم كان أيضا أعلى فى المجموعة المتناولة لخبز قشر البطاطس مقارنة بالمجموعة المتناولة لخبز ردة القمح.
٥. عند تقدير مستوى الكوليسترول الضار منخفض الكثافة فى المجموعات المختبرة ، لوحظ إنخفاض واضح فى مستوى هذا النوع من الكوليسترول بنسبة ٦٦% و ٦١% فى المجموعة المتناولة لخبز قشر البطاطس وخبز ردة القمح ، على التوالى وذلك مقارنة بالمجموعة الثانية المتناولة لوجبة محتوية علي الكوليسترول بدون معاملة.
٦. لوحظ أيضا تحسن واضح فى مستوى الكوليسترول النافع عالى الكثافة حيث إرتفع مستواه بنسبة١٠,٨% و ٧,٨% فى المجموعتين المعاملتين بخبز قشر البطاطس وخبز ردة القمح، على التوالى وذلك مقارنة بالمجموعة الثانية.
٧. كانت مستويات الجلسريدات الثلاثية والكوليستول الضار منخفض الكثافة منخفضة بشكل معنوى فى المجموعة المتناولة للوجبة المحتوية على خبز قشر البطاطس مقارنة بالمجموعة المتناولة للوجبة المحتوية لخبز ردة القمح بنسب ٦٨,٤% مقابل ٧٤,٧%، للجلسيرات الثلاثية و ٣٦,٧% مقابل ٤٢,٨%، للكوليسترول الضار منخفض الكثافة.