**Table 2 Proximate analysis, dietary fiber and cholesterol content of five raw material health foods (sample)**

| Formula (Sample) | Moisture | Protein | Fat | Ash | *SDF | **IDF | Cholesterol (mg/100g) |
|---|---|---|---|---|---|---|---|
| | ◄ | | | (%) | | | ► |
| 1 | 7.81 | 18.11 | 4.67 | 3.34 | 1.88 | 4.69 | 0.00 |
| 2 | 10.93 | 17.61 | 4.95 | 2.82 | 1.47 | 9.66 | 0.00 |
| 3 | 7.51 | 0.87 | 2.80 | 0.67 | 18.89 | 37.08 | 0.00 |
| 4 | 8.90 | 0.19 | 0.77 | 0.24 | 0.85 | 88.37 | 0.00 |
| 5 | 11.31 | 82.45 | 0.50 | 3.62 | 1.18 | 4.58 | 21.70 |

*SDF = Soluble dietary fiber **IDF = Insoluble dietary fiber

Proximate analysis, dietary fiber and cholesterol content of five raw material health foods from dietary fiber source were shown in table 2. Five health foods from dietary fiber were prepared for the experimental diets by AOAC (1998) method (70) which was composed of protein 10 ± 0.3 %, soy oil 8 %, mineral 5 %, vitamin 1 %, cellulose1 %, water 5 %, sucrose 35 % and corn starch 35 %. The composition of five experimental diet, proximate analysis, dietary fiber and cholesterol content were shown in table 3 and 4.

**Table 3 Composition of five experimental diet**

| Diet | Sample | Soy oil | Salt mix. | Vit. mix. | Water | Corn starch | Sucrose | Cellulose | Casein |
|---|---|---|---|---|---|---|---|---|---|
| | ◄ | | | | (g | / 10 kg) | | ► | |
| 1 | 5522 | 542 | 316 | 100 | 69 | 1857 | 1857 | - | - |
| 2 | 5678 | 519 | 340 | 100 | - | 2008 | 2008 | - | - |
| 3 | 2019 | 738 | 443 | 100 | 211 | 2638 | 2638 | - | 1213 |
| 4 | 1266 | 784 | 453 | 100 | 250 | 2967 | 2967 | - | 1213 |
| 5 | - | 794 | 456 | 100 | 363 | 3522 | 3522 | 30 | 1213 |

**Table 4 Proximate analysis, dietary fiber and cholesterol content of five experimental diets**

| Diet | Moisture | Protein | Fat | Ash | *SDF | **IDF | Cholesterol |
|---|---|---|---|---|---|---|---|
| | ◄ | | | (%) | | | ► |
| 1 | 6.64 | 9.82 | 7.76 | 4.35 | 0.26 | 2.60 | 13.00 |
| 2 | 8.35 | 9.79 | 7.78 | 4.13 | 0.26 | 2.60 | 11.40 |
| 3 | 6.49 | 10.20 | 10.44 | 4.22 | 1.55 | 6.21 | 14.20 |
| 4 | 6.56 | 10.20 | 10.61 | 4.18 | 0.27 | 10.12 | 14.10 |
| 5 | 6.30 | 10.33 | 10.64 | 4.29 | 0.55 | 0.03 | 13.50 |

*Soluble dietary fiber, **Insoluble dietary fiber

Fatty acid profile of raw material health foods and experimental diets were shown in table 5 and 6.

**Table 5 Composition of fatty acid in raw material health foods (samples)**

| Fatty acid | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 |
|---|---|---|---|---|---|
| | ◄ | | (g / 100 g) | | ► |
| Caprylic | 0.0047 | 0.0050 | 0.0000 | 0.0000 | 0.0035 |
| Capric | 0.0187 | 0.0050 | 0.0000 | 0.0046 | 0.0154 |
| Lauric | 0.0327 | 0.0297 | 0.0056 | 0.0038 | 0.0198 |
| Myristic | 0.0607 | 0.0248 | 0.0392 | 0.5119 | 0.0545 |
| Palmitic | 1.0733 | 1.0694 | 1.4182 | 0.0958 | 0.1427 |
| Palmitoleic | 0.0140 | 0.0050 | 0.0000 | 0.0230 | 0.0193 |
| Stearic | 0.2800 | 0.2624 | 1.2332 | 0.0291 | 0.0698 |
| Oleic | 1.4466 | 1.5348 | 0.0112 | 0.0352 | 0.1352 |
| Linoleic | 1.4886 | 1.7081 | 0.0084 | 0.0168 | 0.0193 |
| Linolenic | 0.0233 | 0.0297 | 0.0000 | 0.0000 | 0.0015 |
| Gadoleic | 0.1913 | 0.2426 | 0.0252 | 0.0000 | 0.0104 |
| Behenic | 0.0000 | 0.0000 | 0.0028 | 0.0314 | 0.0000 |
| Erucic | 0.0420 | 0.0396 | 0.0588 | 0.0146 | 0.0044 |

**Table 6 Composition of fatty acid in five experimental diets**

| Fatty acid | Diet 1 | Diet 2 | Diet 3 | Diet 4 | Diet 5 |
|---|---|---|---|---|---|
| | ← | | (g / 100 g) | | → |
| Capric | 0.0155 | 0.0078 | 0.0209 | 0.0212 | 0.0213 |
| Lauric | 0.0155 | 0.0156 | 0.0104 | 0.0106 | 0.0106 |
| Myristic | 0.0155 | 0.0078 | 0.0417 | 0.0212 | 0.0319 |
| Palmitic | 1.0089 | 1.0899 | 1.4089 | 1.2098 | 1.2026 |
| Palmitoleic | 0.0155 | 0.0000 | 0.0104 | 0.0212 | 0.0000 |
| Stearic | 0.3492 | 0.3270 | 0.7201 | 0.4457 | 0.4363 |
| Oleic | 1.9401 | 2.0085 | 2.3168 | 2.5470 | 2.5968 |
| Linoleic | 3.7328 | 3.6666 | 4.9989 | 5.3912 | 5.3639 |
| Linolenic | 0.6364 | 0.6228 | 0.8766 | 0.9021 | 0.9259 |
| Behenic | 0.0310 | 0.0389 | 0.0417 | 0.0424 | 0.0426 |

**Analytical procedures**

After 28 days (4 weeks), experimental rats were fasted for 16 hours and anesthetized with ether for sample collection. Blood was drawn by cardiac puncture into test tube and centrifuged at 2500 rpm for 10 min to obtain serum. Serum samples were analyzed by enzymatic colorimetric procedures. Proximate analysis and protein efficiency ratio (PER) were determined by AOAC, 1998. Cholesterol content in foods and diets were measured by HPLC. Fatty acid profile in raw material health foods and experimental diets were analyzed by gas chromatography method. Dietary fiber content was measured by enzymatic – gravimetric method (AOAC, 1998).

**Statistical method**

Datas were statistically analysed using Analysis of Variance (ANOVA) and Duncan' s New Multiple Range Test. A value of $p < 0.05$ was considered significant.

## RESULTS

**Serum triglyceride and cholesterol.** Serum triglyceride levels were significantly lower in rats fed experimental diet from health food composed of nata de coco, unpolished rice, sweet corn and mung bean than those fed experimental diet from apple pectin and cellulose whereas serum cholesterol levels were not significant differences in rats fed experimental diet from nata de coco, unpolished rice, sweet corn, mung bean compared with those fed experimental diet from apple pectin and cellulose (Table 7).

**Table 7 Means of serum triglyceride and cholesterol levels in rats fed five experimental diets**

| Experimental Diet | Triglyceride (mg / dl) | Cholesterol (mg / dl) |
|---|---|---|
| 1 | 105.8 [ab] | 132.1 [ab] |
| 2 | 88.0 [a] | 138.4 [b] |
| 3 | 169.5 [c] | 127.4 [ab] |
| 4 | 134.8 [b] | 130.4 [ab] |
| 5 | 120.8 [ab] | 123.4 [a] |

Significant difference at $P < 0.05$

**Body weight, food intake, fecal weight and PER.**

The mean initial weight of rats was similar for all treatments but the mean final body weight of experimental diet 2 was significantly lower than those fed the other four treatments. The mean food intake of rats given diet 2 was similar as those fed diet 5 but significantly lower than those fed the other three experimental diets. The mean weight of feces was significantly difference among rat fed five experimental diets. Corrected protein efficiency ratio (PER) of rats fed experimental diet 2 was significantly lower than those fed the other four experimental diets (Table 8).

**Table 8 Means of body weight, food intake, fecal weight and protein efficiency ratio (PER) of rats fed five experimental diets**

| Experimental Diets | Initial wt. | Final wt. | Food intake | Fecal wt. | PER |
|---|---|---|---|---|---|
| | ◄ | (g) | | ► | |
| 1 | 56.88 | 171.49$^{b}$ | 14.40$^{b}$ | 9.22$^{b}$ | 2.36$^{b}$ |
| 2 | 56.67 | 127.51$^{a}$ | 12.09$^{a}$ | 10.75$^{c}$ | 1.81$^{a}$ |
| 3 | 57.13 | 184.11$^{b}$ | 14.44$^{b}$ | 16.89$^{d}$ | 2.54$^{c}$ |
| 4 | 57.21 | 179.19$^{b}$ | 14.14$^{b}$ | 18.29$^{c}$ | 2.48$^{c}$ |
| 5 | 57.11 | 173.37$^{b}$ | 12.96$^{a}$ | 5.08$^{e}$ | 2.50$^{c}$ |

Significantly different ($p < 0.05$) using Duncan's new multiple range test

## DISCUSSION

Table 8 was shown that rats fed the experimental diet 2 was significantly lower food intake so the final body weight and PER were significantly lower than those fed the other experimental diet whereas rats fed experimental diet 5 was significantly lowest because this experimental diet consisted of only 0.58 % total dietary fiber (Table 4).

Health food from dietary fiber was produced in this study, composed of 40 % nata de coco, 6 % unpolished rice, 30 % sweet corn, 18 % mung bean (diet 2) was the best lowering effect of serum triglyceride in experimental rats compared with those fed apple pectin (diet 3) and cellulose (diet 4), even though total dietary fiber content in diet 2 (2.86 %) was lower than apple pectin diet 3 (7.76 %) and 4 cellulose diet (10.39 %). Serum cholesterol levels in rats fed three experimental diets (diet 2, 3, 4) were not significantly difference which may be because of nearly the same cholesterol content in the experimental diet 2, 3, 4; 11.40, 14.20 and 14.10 % respectively.

Although percentage of soluble fiber to total dietary fiber in diet 2, 3, 4 were differently 9.09, 19.97, 2.60 respectively, serum cholesterol levels in rats were not significant different which was contrast with study of Anderson JW. et al. (1994) (71), they studied in ten dietary fibers in male Sprague – Dawley rats for 3 weeks. The results showed that rat fed pylliums which consisted of high soluble fiber was lowest serum cholesterol whereas other soluble fiber such as oat gum, guar gum and pectin were less reduce serum cholesterol than rats fed cellulose which was insoluble fiber. They indicated

that soluble fiber was lower serum cholesterol in rat than insoluble fiber but in our study, different content of soluble and insoluble fiber in experimental diets did not effect the serum cholesterol levels in the experimental rats.

In according to Anderson JW. et al. (1991) (72), the serum triglyceride levels significantly ($p < 0.04$) decreased by 10 % in hypercholesterolemia men consuming wheat bran 40 g/d. The results of our study showed the serum triglyceride lowering effect of health food product from 40 % nata de coco, 6 % unpolished rice, 36 % sweet corn, 18 % mung bean which was highly insoluble fiber, so our results may indicate that the insoluble fiber in health food product from those composition significantly reduced serum triglyceride in experimental rats.

## CONCLUSION

High dietary fiber from nata de coco, unpolished rice, sweet corn, mung bean in this study, was prepared for experimental diet with the lowest cholesterol content which was significantly lower the serum triglyceride level in experimental rats than those fed the experimental diet from apple pectin and cellulose even though the percentage of total dietary fiber was lower than those two experimental diet (apple pectin and cellulose) but no serum cholesterol – lowering effect. The results imply that the insoluble fiber in high dietary fiber food from 40 % nata de coco, 6 % unpolished rice, 36 % sweet corn, 18 % mung bean may reduce serum triglyceride in the experimental rats. This high dietary fiber food can be applied for health food in treatment and protection the patients from hyperlipidemic especially hypertriglyceridemic patients and normal population.

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## REFERENCES


1. Trowell HC (1973) Dietary fiber, ischemic heart disease and diabetes mellitus. Proc Nutr Soc 32 : 151 – 157
2. Spiller GA (1993) Definition of dietary fiber. In Spiller GA (ed), Dietary fiber in human Nutrition, 2 nd ed. CRC Press, Boca Raton, FL, pp 15 – 18
3. Werch SC, Ivy AC (1941) A study of the metabolism of ingested pectin. Am J Dis Child 62 : 499 – 511
4. Kay RM (1982) Dietary fiber. J Lipid Res 23 : 221 – 242
5. Gallaher DD, Schneeman BO (1996) Dietary fiber. In Ziegler EE, Filer LJ (eds), Present knowledge in nutrition 7 th ed. ILSI Press, Washington, DC, pp 87 – 97
6. Story JA, Kritchevsky, D (1976) Dietary fiber and lipid metabolism. In spiller GA, Amen RJ (eds), Fiber in human nutrition. Plenum Press, New York, pp 171 – 184
7. Anderson JW, Deakins DA, Floore TL, et al (1990) Dietary fiber and coronary heart disease. Crit Rev Food Sci Nutr 29 : 95 – 147
8. Story JA, Thomas JN (1982) Modification of bile acid spectrum by dietary fiber. In Vahouny GV, Kritchevsky D (eds), Dietary fiber in health and disease. Plenum Press, New York, pp 193-201
9. Everson GT, Daggy BP, McKinley C, et al (1992) Effects of psyllium hydrophilic mucilloid on LDL-cholesterol and bile acid synthesis in hypercholesterolemic men. J Lipid Res 33 : 1183 - 1192
10. Marlett JA, Hosig KB, Vollendorf NW, et al (1994) Mechanism of serum cholesterol reduction by oat bran. Hepatology 20 : 1450 - 1457
11. Eastwood MA, Morris ER (1992) Physical properties of dietary fiber that influence physiological function : a model for polymers along the gastrointestinal tract. Am J Clin Nutr 55 : 436 - 442
12. Ebihara K, Schneeman BO (1989) Interaction of bile acids, phospholipids, cholesterol And triglyceride with dietary fibers in the small intestine of rats. J Nutr 119 : 1100 - 1106

13. Miettinen TA, Tarpila S (1989) Serum lipids and cholesterol metabolism during guar gum, plantago ovata and high fibre treatments. Clin Chim Acta 183 : 253 - 262

14. Kelley JJ, Tsai AC (1978) Effect of pectin, gum arabic and agar on cholesterol absorption, synthesis, and turnover in rats. J Nutr 108 : 630 - 639

15. Fernandez ML, Lin EC, Trejo A, et al (1994) Prickly pear (Opuntia sp.) pectin alters hepatic cholesterol metabolism without affecting cholesterol absorption in guinea pigs fed a hypercholesterolemic diet. J Nutr 124 : 817 - 824

16. Carr TP, Gallaher DD, Yang C-H, et al (1996) Intestinal contents viscosity and cholesterol absorption efficiency in hamsters fed hydroxypropyl methylcellulose. J Nutr (in press).

17. Mokady S (1974) Effects of dietary pectin and algin on the biosynthesis of hepatic lipids in growing rats. Nutr Metab 16 : 203 - 207

18. Nishina PM, Schneeman BO, Freedland RA (1991) Effects of dietary fibers on nonfasting plasma lipoprotein and apolipoprotein levels in rats. J Nutr 121 : 431 – 437

19. Tinker L, Davis PA, Schneeman BO (1994) Prune fiber or pectin compared to cellulose lowers plasma and liver lipids in rats with diet-induced hyperlipidemia. J Nutr 124 : 31 - 40

20. Nishina PM, Freedland RA (1990) Effects of propionate on lipid biosynthesis in isolated rat hepatocytes. J Nutr 120 : 668 - 673

21. Hudgins L, Hellerstein M, Seldman C, et al (1993) Increased de novo lipogenesis on a eucaloric low fat high carbohydrate diet does not alter energy expenditure [abstract]. Obesity Res 1 (suppl 2) : 92S

22. Wolever TMS, Jenkins DJA (1993) Effect of fiber and foods on carbohydrate metabolism. In Spiller GA (ed), Dietary fiber in human nutrition, 2nd ed. CRC Press, Boca Raton, FL, pp 111 - 152

23. Peterson DB, Ellis PR, Baylis JM, et al (1987) Low dose guar in a novel food product: improved metabolic control in noninsulin-dependent diabetes. Diab Med 4 : 111 - 115

24. Gallaher DD, Olson JM, Larntz K (1992) Guar gum halts further renal enlargement in rats with established diabetes. J Nutr 122 : 2391 - 2397

25. Seyer-Hansen K (1977) Renal hypertrophy in experimental diabetes : relation to severity of diabetes. Diabetologia 13 : 141 - 143

26. Jenkins DJA, Wolever TMS, Leeds AR, et al (1978) Dietary fibres, fibre analogues, and glucose tolerance: importance of viscosity. Br Med J i : 1392 - 1394

27. Edwards CA, Blackburn NA, Craigen L, et al (1987) Viscosity of food gums determined in vitro related to their hypoglycemic actions. Am J Clin Nutr 46 : 72 - 77

28. Schwartz SE, Levine RA, Singh A, et al (1982) Sustained pectin ingestion delays gastric emptying. Gastroenterology 83 : 812 - 817

29. Torsdottir I, Alpsten M, Andersson H, et al (1989) Dietary guar gum effects on postprandial blood glucose, insulin and hydroxyproline in humans. J Nutr 119 : 1925 - 1931

30. Leclere CJ, Champ M, Boillot J, et al (1994) Role of viscous guar gums in lowering the glycemic response after a solid meal. Am J Clin Nutr 59 : 914 - 921

31. Blackburn NA, Redfern JS, Jarjis H, et al (1984) The mechanism of action of guar gum in improving glucose tolerance in man. Clin Sci Molec Med 66 : 329 - 336

32. LSRO (Life Sciences Research Office) (1987) In Pilch SM (ed), Physiological effects and health consequences of dietary fiber. Federation of American Societies for Experimental Biology, Bethesda, MD

33. Spiller GA (1993) Suggestions for a basis on which to determine a desirable intake of dietary fiber. In Spiller GA (ed), Dietary fiber in human nutrition, 2nd ed. CRC Press, Boca Raton, FL, pp 351 - 354

34. Cummings JH, Bingham SA, Heaton KW, Eastwood MA (1992) Fecal weight, colon cancer risk and dietary intake of non-starch polysaccharides (dietary fiber). Gastroenterology 103 : 1783 - 1789

35. Cummings JH (1993) The effect of dietary fiber on fecal weight and composition. In Spiller GA (ed), Dietary fiber in human nutrition, 2nd ed. CRC Press, Boca Raton, FL, pp 263 - 349

36. Brodribb AJM, Groves C (1978) Effect of bran particle size on stool weight. Gut 19 : 60 - 63

37. Heller SN, Hackler LR, Rivers JM, et al (1980) Dietary fiber : the effect of particle size of wheat bran on colonic function in young adult men. Am J Clin Nutr 33 : 1734 - 1744

38. UK Department of Health (1991) Dietary reference values for food energy and nutrients for the United Kingdom. H Majesty's Stationery Office, London, pp 61 – 71

39. Augeron C, Laboisse CL (1984) Emergence of permanent differentiated cell clones in a human colonic cancer celine in culture acter treatment with sodium butyrate. Cancer Res 44 : 3961 - 3969

40. Sakata T (1987) Stimulatory effect of short-chain fatty acids on epithelial cell proliferation in the rat intestine : a possible explanation for trophic effects of fermentable fibre gut microbes and luminal trophic factors. Br J Nutr 58 : 95 - 103

41. Jacobs LR, Lupton JR (1984) Effect of dietary fibers on rat large bowel mucosal growth and cell proliferation. Am Physiol 246 : G378 - 385

42. McIntyre A, Gibson PR, Young GP (1993) Butyrate production from dietary fibre and protection against large bowel cancer in a rat model. Gut 34 : 386 - 391

43. Schneeman BO, Gallaher DD (1993) Effects of dietary fiber on digestive enzymes. In Spiller GA (ed), Dietary fiber in human nutrition, 2nd ed. CRC Press, Boca Raton, FL, pp 377-385

44. Gallaher DD, Schneeman BO (1986) Nutritional and metabolic response to plant inhibitors of digestive enzymes. In Friedman M (ed), Advances in experimental medicine and biology, vol 199 : Nutritional and toxicological significance of enzyme inhibitors in foods. Plenum Press, New York, pp 167 - 184

45. Gallaher DD, Schneeman BO (1985) Effect of dietary cellulose on site of lipid absorption. Am J Physiol 249 : G184 – G191

46. Lairon D, Lafont H, Vigne JL, et al (1985) Effects of dietary fibers and cholestyramine on the activity of pancreatic lipase in vitro. Am J Clin Nutr 42 : 629 - 638

47. Lairon D, Borel E, Termine R, et al (1985) Evidence for a proteinic inhibitor of pancreatic lipase in cereals, wheat bran and wheat germ. Nutr Rep Int 32 : 1107 - 1113

48. Cara L, Dubois C, Borel P, et al (1992) Effects of oat bran, wheat fiber, and wheat germ on postprandial lipemia in healthy adults. Am J Clin Nutr 55 : 81 - 88

49. Isaksson G, Lundquist B, Akesson B, Ihse I (1984) Effects of pectin and wheat bran on intraluminal pancreatic enzyme activities and on fat absorption as examined with the triolein breath test in patients with pancreatic insufficiency. Scand J Gastroenterol 19 : 467 - 472

50. Collier G, O'Dea K (1982) Effect of physical form of carbohydrate on the postprandial glucose, insulin and gastric inhibitory polypeptide responses in type 2 diabetes. Am J Clin Nutr 36 : 10 - 14

51. Snow P, O'Dea K (1981) Factors affecting the rate of hydrolysis of starch in food. Am J Clin Nutr 34 : 2721 - 2727

52. Wong S, O'Deak (1983) Importance of physical form rather than viscosity in determining the rate of starch hydrolysis in legumes. Am J Clin Nutr 37 : 66 - 70

53. Kasper H (1993) Effects of dietary fiber on vitamin metabolism. In Spiller GA (ed), Dietary fiber in human nutrition, 2nd ed. CRC Press, Boca Raton, FL, pp 253 - 260

54. Torre M, Rodriguez AR, Saura-Calixto F (1991) Effects of dietary fiber and phytic acid on mineral availability. Crit Rev Food Sci Nutr 1 (1) : 1 - 22

55. Sandstrom B, Almgren A, Kivistoe B, Cederblad A (1987) Zinc absorption in humans from meals based on rye, barley, oat meal, triticale, and whole wheat. J Nutr 117 : 1898 - 1902

56. Schneeman BO (1982) Pancreatic and digestive function. In Vahouny GV, Kritchevsky D (eds), Dietary fiber in health and disease. Plenum Press, New York, pp 73 - 83

57. Sandberg AS, Ahderinee R, Andersson H, et al (1983) The effect of citrus pectin on the absorption of nutrients in the small intestine. Hum Nutr Clin Nutr 37C : 171 - 183

58. Sandberg AS, Andersson H, Hallgren B, et al (1981) Experimental model for in vivo determination of dietary fibre and its effect on the absorption of nutrients in the small intestine. Br J Nutr 45 : 283 - 294

59. Blackburn NA, Johnson IT (1981) The effect of guar gum on the viscosity of the gastrointestinal contents and on glucose uptake from the perfused jejunum in the rat. Br J Nutr 46:239 - 246

60. Elsenhans B, Sufke U, Blume R, Caspary WF (1980) The influence of carbohydrate gelling agents on rat intestinal transport of monosaccharides and neutral amino acids in vitro. Clin Sci 59 : 373 - 380

61. Johnson IT, Gee JM (1981) Effect of gel-forming gums on the intestinal unstirred layer and sugar transport in vitro. Gut 22 : 398 - 403

62. Schneeman BO (1994) Carbohydrates : significance for energy balance and gastrointestinal function. J Nutr 124 : 1747S – 1753S

63. Vahouny GV, Satchitanandam S, Chen I, et al (1988) Dietary fiber and intestinal adaptation : effect on lipid absorption and lymphatic transport in the rat. Am J Clin Nutr 47 : 201 - 206

64. Vahouny GV (1982) Dietary fibers and intestinal absorption of lipids. In Vahouny GV, Kritchevsky D. (eds), Dietary fiber in health and disease. Plenum Press, New York, pp 203 - 227

65. Jenkins DJA (1978) Action of dietary fiber in lowering fasting serum cholesterol and reducing postprandial glycemia : gastrointestinal mechanisms. In Carlson LA (ed), International conference on atherosclerosis. Raven Press, New York, pp 173 - 182

66. Wu AL, Clark SB, Holt PR (1980) Composition of lymph chylomicrons from proximal or distal rat small intestine. Am J Clin Nutr 33 : 582 - 589

67. Spiller RC, Trotman IF, Adrian TE, et al (1988) Further characterization of the "ileal brake" reflex in man : effect of ileal infusion of partial digests of fat, protein and starch on jejunal motility and release of neurotensin, enteroglucagon and peptide YY. Gut 29 : 1042 - 1051

68. Sigleo S, Jackson Mj, Vahouny GV (1984) Effects of dietary fiber constituents on intestinal morphology and nutrient transport. Am J Physiol 246 : G34 – G 39

69. Johnson LR (1988) Regulation of gastrointestinal mucosal growth. Physiol Rev 68 : 456 - 502

70. AOAC (1998) Official methods of analysis 16 th ed. Association of Official Analytical Chemists, Gaithersburg, Maryland.

71. Anderson JW, Jones AF, Mason SR (1994) Ten different dietary fibers have significantly different effects on serum and liver lipids of cholesterol – fed rats. J Nutr 124 : 78 – 83.

72. Anderson JW, Gilinsky NH, Deakins DA, et al. (1991) Lipid responses of hypercholesterolemic men to oat – bran and wheat – bran intake. Am J Clin Nutr 54 : 678 – 683.