Dietary Raw Peas (*Pisum sativum* L.) Reduce Plasma Total and LDL Cholesterol and Hepatic Esterified Cholesterol in Intact and Ileorectal Anastomosed Pigs Fed Cholesterol-Rich Diets[1]

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ABSTRACT Previous studies demonstrated the cholesterol-lowering effect of dietary legumes (mainly soybeans) in animals and humans, but the mechanisms by which they exert this effect are not completely understood. The contribution of the hindgut to this hypocholesterolemic effect is also not well documented. The present work was undertaken to investigate the effect of cholesterol-enriched (2.8 g/kg) casein (C) and raw pea seed (RP) diets on the cholesterol metabolism of intact (I) and ileorectal anastomosed (IRA) growing pigs. Four groups of 6 pigs were allocated to the treatments (C-I, C-IRA, RP-I, and RP-IRA pigs) for 3 wk. Plasma total cholesterol was lowered by the RP diet through a significant decrease in LDL cholesterol. The RP diet also decreased the hepatic concentration of esterified cholesterol and increased 3-hydroxy-3-methylglutaryl CoA reductase activity and LDL receptor synthesis. The biliary total cholesterol and bile acid concentrations were greater in RP- than in C-fed pigs. In addition, fecal bile acid output was higher in RP-fed pigs. The cecum-colon by-pass inhibited cholesterol and β-sitosterol microbial transformation, lowered the bile acid output, and increased the primary to secondary bile acid output ratio, but its influence on cholesterolemia was negligible. These results suggest a hypocholesterolemic effect of the raw pea diet probably due to increased fecal bile acid output and an increased biliary bile acid concentration. J. Nutr. 134: 3305–3312, 2004.

KEY WORDS: • *raw pea seeds* • *ileorectal anastomosis* • *pig* • *cholesterol metabolism* • *steroid output*

The cholesterol-lowering effects of legumes in humans and animal models were found in several studies (1–4) but in others, these effects were not present (5,6). Several mechanisms were proposed to explain this cholesterol-lowering effect; these involved legume components such as proteins and their amino acid profiles (7,8), lipid fractions, fiber (3), saponins (9,10), and phytosterols (11,12). These components could act through metabolic mechanisms, usually involving plasma amino acid or hormone concentrations (13), PUFA absorption (3), or gastrointestinal mechanisms affecting either the intestinal microflora or the enterohepatic metabolism of steroids (2,14–16).

Peas are important food legumes with a world production exceeded only by soybeans, peanuts, and dry beans. For both humans and animals, dry pea seeds are a potentially rich source of protein and carbohydrates (17). A few studies were undertaken to assess the effect of peas on cholesterol metabolism, using pigs (18,19) as models for humans. This omnivorous animal is considered to be a good model for the study of diet effects on plasma cholesterol and atherosclerosis because of its physiologic and anatomical similarities to humans (20). Although a relation between cholesterolemia and intestinal digestive processes was demonstrated, the role of the hindgut and its microflora is still unclear, in contrast to the known role played by the small intestine (21,22). The microbial transformation of primary into secondary bile acids in the hindgut, for instance, could play an important regulatory role (23) because the absorption of hydrophobic secondary bile acids modulates cholesterol and bile acid synthesis in the liver (24). Thus, the by-pass of the cecum-colon section by an ileorectal anastomosis (IRA)[3] allows an analysis of the role of this part of the digestive tract in cholesterol metabolism and steroid output.

The aim of the present study was to evaluate the effects of feeding whole raw pea seeds and the role of the cecum-colon

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[3] Abbreviations used: BW, body weight; C, casein; CYP7A1, cholesterol 7α-hydroxylase; CYP27A1, sterol 27-hydroxylase; HMG CoA, 3-hydroxy-3-methylglutaryl CoA; I, intact; IRA, ileorectal anastomosis; NDF, neutral detergent fiber; NSP, nonstarch polysaccharide; RP, raw pea seed; TTBS, Tween-Tris buffered saline.

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