HEALTH AND WELLNESS

Introduction

Pectin is a natural polysaccharide hydrocolloid isolated from plant materials or seeds. It is resistant to digestion and absorption in the small intestine and undergoes complete or partial fermentation in the large intestine. Hence, it can be classified as a soluble fibre (1). Consumption of plant materials, seeds or foods rich in or enriched with pectin can make a significant contribution to the daily recommended fibre intake of more than 25g (2).

Health benefits of fibres in general have been described in relation to (3):

Digestive health

- Decrease in intestinal transit time and increase in stool bulk associated with a reduced risk of constipation
- Fermentation by colonic microflora and generation of short-chain fatty acids (SCFA)
- Improvement of gut barrier function

Cardiovascular health

- Reduction in total and low density lipoprotein (LDL) serum cholesterol levels by changing absorption of cholesterol or re-absorption of bile acids
- Reduction in postprandial triglycerides

Glucose metabolism and diabetes

- Reduction in glycaemic response and insulin demand

Weight management

- Increase in satiety by delaying gastric emptying or reducing glycaemic response

Some of these health benefits have been specifically investigated for pectin. In addition, other health benefits or positive effects on disease risk biomarkers not associated with their attributes as viscous, soluble fibres have been reported. These include prebiotic activity, anti-carcinogenic activity and detoxifying effects.

Health benefits of pectin as a dietary fibre

Digestive health

Pectin is not digested or absorbed in the upper gastrointestinal tract and is extensively fermented by the colonic microflora with highly esterified pectin types being more slowly fermented (4). Pectin is broken down by pectate lyase to form oligo-galacturonic acids which are fermented to form gases and SCFA, where acetate accounts for more than 80% of the fatty acids generated (5). As pectin is completely fermented, its effect on increasing stool bulk and intestinal transit time is minimal (6, 7).

The extensive fermentation of pectin and associated generation of SCFA, however, may stimulate colonic salt and water absorption and, thus, reduce fluid loss due to diarrhoea. Such a reduction in stool frequency and diarrhoea duration, along with improved stool consistency, was observed in subjects following dietary supplementation with pectin at a dose of 4g/kg body weight (bw) (8,9).

Cardiovascular health

Multiple studies have been carried out to assess the cholesterol-lowering properties of pectin, looking at a variety of subjects with varying starting levels of cholesterol, differing pectin doses and pectin from various sources (10). Most studies have shown significant cholesterol reductions and the most appropriately designed studies have been included in a meta-analysis (11). This meta-analysis included only studies that met certain key criteria. Studies had to follow a controlled, randomised crossover or parallel design, report lipid changes that allow calculation of treatment effect, have an intervention period of ≥14 days, use a soluble fibre from a single source, use an identifiable amount of fibre, and make dietary changes for study groups under isoenergetic conditions (11).

Seven pectin studies, employing a total of 277 subjects met these criteria, and significant reductions in total cholesterol (-0.070mmol/L or 2.69mg/dL per gram pectin) and LDL cholesterol (-0.055mmol/L or 1.96mg/dL per gram pectin) were reported. Pectin proved more effective than all other fibres (notably oat products, psyllium and guar gum) included in the meta-analysis. The reductions in total cholesterol ranged from 2 – 10% and were mainly attributable to a decrease in LDL cholesterol with little change in high density lipoprotein (HDL) cholesterol.

Contrary to what has been reported from animal studies, the degree of pectin esterification does not seem to influence the cholesterol-lowering properties. Both citrus pectin with a high degree of esterification (71%) and citrus pectin with a low degree of esterification (37%) reduced total cholesterol to a similar extent (18% and 16%, respectively) when administered to healthy subjects at 15g/day for 3 weeks. There was no difference in fat and steroid excretion between the 2 study groups (12).

However, sugar beet pectin (16g/day of extract containing 3.9g of water-soluble, mainly pectin, fibre) failed to lower total cholesterol in a randomised, double-blind, placebo-controlled study in subjects with abnormal glucose metabolism, but increased HDL cholesterol compared to baseline levels within the group (13).

Although the reduction in total cholesterol following pectin consumption is at 2–10% relatively modest, the effect may help to achieve a desirable lipid profile and, thereby, reduce the risk of cardiovascular disease.

Glucose metabolism and diabetes

Human intervention studies have established that the inclusion of certain forms of dietary fibre, particularly soluble and gelling fibres, such as pectin and guar gum, or fibres rich in beta-glucans, such as oat bran, reduce postprandial hyperglycaemia and hyperinsulinaemia in healthy and diabetic subjects (14, 15). Wolever and Jenkins found that pectin reduced postprandial blood glucose response on average by 29%.

The mechanisms explaining the effects of pectin on postprandial glucose metabolism may involve slowing of gastric emptying, starch hydrolysis and glucose absorption by the small intestine.

There is promising evidence that pectin consumption at mealtimes induces a reduction in postprandial glycaemia. However, no data are available at present to suggest that pectin intake decreases glycated haemoglobin, a marker for blood glucose control, and, hence, reduces the risk of long-term complications associated with diabetes.

Weight management

Satiety describes a period of variable duration characterised by the absence of hunger. The termination of the period of satiety coincides with a resurgence of the feeling of hunger leading to consumption of the next meal (16). Satietogenic foods or ingredients may result in reduced energy intake at a subsequent meal or during the course of a day. In the long run, they may result in weight loss or be useful for weight management strategies, as they may help consumers adhere to a low-calorie diet. Due to the number of confounding variables in long-term weight loss studies, however, it is difficult to demonstrate significant effects of satietogenic foods or ingredients on bw.

Pectin increased satiety, as measured by visual analogue scales, when used as the sole source of fibre at a dose of at least 5g. These findings are in line with results from earlier studies that investigated the effects of pectin-containing foods such as peeled oranges or apples (17, 18). However, no effects on energy intake at the next meal or during the course of the day were assessed in these studies.

The mechanism by which pectin may act with regard to the induction of satiety may be attributable to delayed gastric emptying or reduction of glycaemic response when pectin is included in a meal.

Summary

Pectin has benefits for human health relating to its function as a soluble dietary fibre, some of which have been demonstrated specifically for pectin, particularly its cholesterol-lowering properties. Promising specific data also exist from human intervention studies showing a beneficial effect on post-prandial glycaemic response and satiety. Some studies also suggest that pectin has antidiarrhoeal properties. In addition, pectin may have benefits beyond its function as a dietary fibre. Studies have shown prebiotic activity in colon simulation models, anti-carcinogenic activity and detoxifying effects, particularly with regard to radioactive caesium-137.

Certain data gaps still exist which may limit the possibility for pectin-specific health claims. Applying the PASSCLAIM categories of evidence for scientific substantiation (19), the health benefits of pectin are summarised in figure 1.

For more detailed information about the supporting evidence refer to Danisco TP 24-1e *Health Benefits of pectin, guar gum and alginate as dietary fibres and*

Health/nutritional benefit	**Supporting evidence *In vitro*, animal studies**	**Evidence from observational studies**	**Evidence from human intervention studies**
Cholesterol-lowering (cardiovascular health)	Existing	Limited IMT progression ↓ TC:HDL ration ↓	Strong (minimum effective dose?)
Inducing satiety (weight management)	Mechanistic evidence such as delayed gastric emptying	None identified	Promising (measured by VAS)
Reducing glycaemic response	Mechanistic evidence such as delayed gastric emptying	No specific data	Promising
Anti-diarrhorea activity	Mechanistic evidence such as generation of SCFA	None identified	Some (more data needed for pectin alone)
Prebiotic activity	Existing based on colon simulation models	None identified	Largely missing (more data needed)
Anti-carcinogenic activity (for a specific mod. citrus pectin)	Existing for prostate cancer models	None identified	Pilot study for prostate cancer (more data needed)
Detoxifying effects	Mechanistic evidence	None identified	Some for lead and caesium 137 (more data needed)

INCREASING RELEVANCE OF SCIENTIFIC EVIDENCE →

Figure 1. Summary of health benefits of pectin.

beyond – focusing on evidence from human intervention studies.

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