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Processing of oat: the impact on oat's cholesterol lowering effect

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Epidemiological and interventional studies have clearly demonstrated the beneficial impact of consuming oat and oat-based products on serum cholesterol and other markers of cardiovascular disease. The cholesterol-lowering effect of oat is thought to be associated with the β -glucan it contains. However, not all food products containing β -glucan seem to lead to the same health outcome. Overall, highly processed β -glucan sources (where the oat tissue is highly disrupted) appear to be less effective at reducing serum cholesterol, but the reasons are not well understood. Therefore, the mechanisms involved still need further clarification. The purpose of this paper is to review current evidence of the cholesterol-lowering effect of oat in the context of the structure and complexity of the oat matrix. The possibility of a synergistic action and interaction between the oat constituents promoting hypocholesterolaemia is also discussed. A review of the literature suggested that for a similar dose of β -glucan, (1) liquid oat-based foods seem to give more consistent, but moderate reductions in cholesterol than semi-solid or solid foods where the results are more variable; (2) the quantity of β -glucan and the molecular weight at expected consumption levels (~ 3 g day⁻¹) play a role in cholesterol reduction; and (3) unrefined β -glucan-rich oat-based foods (where some of the plant tissue remains intact) often appear more efficient at lowering cholesterol than purified β -glucan added as an ingredient.

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1. Introduction

It is widely recognized that the intake of dietary fibre in a typical Western diet is below recommendations. Oat is one of several grains eaten as part of a Western diet but its consumption and global production are much lower compared to the staple crops wheat, maize, rice, and barley.¹ One of the reasons for its low global production could be a lack of diversity in the oat products commercially available. However, studies reveal the multiple beneficial effects on health associated with oat consumption, ranging from reduction in risk of cardiovascular diseases²⁻⁴ to cancer prevention.^{5,6} Compared with other cereals, oats have higher concentrations of certain nutrients and phytochemicals (*e.g.*, essential amino acids and fatty acids, β -glucan and phenolic compounds), and they can

tolerate harsher growing conditions such as wet climate and acidic soil, making them more resilient than other crops.⁷

In the ageing population of Western countries, cardiovascular disease (CVD) and related conditions are a huge public health burden. According to the World Health Organisation (WHO), CVD is the number one cause of death globally. For example, in 2015, 17.7 million people died from CVD. Elevated serum cholesterol (hypercholesterolaemia) is a significant risk factor for developing CVD. Hypercholesterolaemia can be treated by prescribing statins but this therapy is associated with various negative side-effects. Diet is a key risk factor for the development and prevention of CVD.⁸ Thus, using dietary approaches that tackle risk factors such as increased serum cholesterol levels and high systolic blood pressure should be a key strategy for the prevention of CVD and other metabolic disorders.

The first study to reveal that oat consumption reduced plasma cholesterol levels goes back to 1963.⁹ By enriching bread with rolled oat, the authors observed an 11% reduction in total cholesterol levels. Since then a multitude of *in vivo* and *in vitro* investigations have been conducted to understand the reasons behind this positive effect.^{2-4,10-15} To date, the cholesterol-lowering effect of oat has been attributed primarily to the β -glucan it contains.^{2,3,10,13,14} Although the precise mechanisms involved are not completely understood, the ability of

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