Performance of Pea Hull Fibre & Cellulose Fibre in a White Pan Bread Application

Summary of Final Report

Project 3557

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The demand for dietary fibre is increasing due to the associated health benefits; however, the public's consumption of fibre is still low. White pan bread is a staple of the Western diet but it typically lacks fibre; thus, it is a good vehicle for fibre enrichment. In Canada, pea hull fibre can be used for bread enrichment and cellulose fibre is not permitted. However in the US, lower priced cellulose fibre is allowed in bread and has replaced pea fibre in that market.

The objective of this project was to assess the effects of adding pea hull fibre or cellulose fibre to white pan bread to better understand how fibre source and attributes impact dough handling and bread quality. Limited information exists on the effect of pea fibre in a white pan bread application therefore the aim of this research was to identify advantages and challenges to using pea fibre in bread that could potentially increase its competitiveness in this market.

Based on literature, it was determined that 2g fibre/50g bread serving was a suitable fibre addition level so other fibre addition levels were not tested. Additionally, as all breads contained 2g fibre per slice, a nutritional comparison was unnecessary.

Three pea fibres (A, B, & C) and two cellulose fibres (A & B) from four manufacturers were characterized and tested in dough and bread and compared to a control without added fibre (Figure 1 & 2). Fibre properties (content, particle size, water holding capacity (WHC), colour, antioxidant (AOX) level); dough mixing properties (dough development time (DDT), mixing tolerance index (MTI), mixing time and energy); objective indicators of bread quality (oven spring (OS), loaf volume (LV), moisture, texture, colour, AOX level); and sensory attributes of bread (crumb grain, crumb texture, crust texture, aroma, flavour, overall quality) were evaluated. Objective and sensory properties of the breads were measured after one and seven days to assess the effect of storage on bread quality.

Figure 1. Photograph of the exterior of the control bread and those enriched with either cellulose or pea fibre[a]

[z] from left to right: control, Cellulose A, Cellulose B, Pea A, Pea B, & Pea C

Figure 2. Photograph of the interior crumb of the control bread and those enriched with cellulose or pea fibre[a]

[a] from left to right: control, Cellulose A, Cellulose B, Pea A, Pea B, & Pea C

Pea fibre had lower total dietary fibre (TDF) and insoluble fibre, higher soluble fibre, larger particles, lower WHC, more yellow tones, and less brightness compared to cellulose fibre. In addition, dry milled pea fibres A & B exhibited AOX activity whereas, wet milled cellulose fibres and pea fibre C did not. Incorporation of pea fibre decreased mixing time and generally produced softer bread (objectively) than cellulose fibre. Based on manufacturer's pricing, pea fibre addition increased cost of the flour/fibre blend by $2.06-5.57/kg compared to cellulose fibre.

Properties of the three pea fibres differed and subsequently performance differences were also observed. Dry milled pea fibres contained more soluble fibre and AOX, were less bright, had a lower WHC, and were less expensive than wet milled pea fibre. Doughs prepared with dry milled pea fibre had a higher MTI and breads were darker in colour and contained more AOX than those made with wet milled pea fibre.

Incorporation of cellulose fibre decreased the DDT of the fibre/flour blends, increased dough mixing time, and produced bread with a firm crumb compared to pea fibre. Both cellulose fibres performed similarly to each other but cellulose fibre A produced bread that had slightly better OS and LV. It also had the highest WHC of all fibres tested.

In general, fibre addition regardless of the source decreased LV and OS due to dilution of the gluten. Therefore, using a fibre with high TDF will maximize the amount of flour (gluten) in the dough and consequently minimize the impact of fibre addition on bread quality. The addition of fibre also reduced the energy required for dough development. All breads enriched with fibre were rated similar to the control bread for flavour, crumb texture, and overall sensory quality at Days 1 and 7 except for bread prepared with pea fibre B which was rated lower after seven days storage. Some AOX activity was observed in bread containing pea fibre A but the presence of AOX did not extend the shelf life of the bread.

There are numerous advantages to using pea fibre in a white bread application. Pea fibre addition (2g fibre/slice) can:

- Produce bread with similar flavour and overall quality as control and cellulose breads,
- Increase crumb softness (instrumentally) after seven days of storage compared to control and cellulose fibre breads,
- Improve mixing tolerance compared to control and cellulose fibre doughs,
- Slightly decrease the energy required to fully develop dough compared to control & cellulose fibre doughs,

- Aid in moisture retention after seven days storage compared to control and cellulose fibre breads,
- Reduce mixing time compared to doughs containing cellulose fibre, and
- Increase the AOX activity compared to control and cellulose fibre breads.

The challenges of adding pea fibre to bread include:

- Increased DDT compared to control and cellulose fibre doughs,
- Decreased OS and LV compared to control and cellulose fibre breads, and
- Increased in use cost compared to cellulose fibre.

The TDF, composition, particle size, and manufacturing method of pea fibre impacts dough handling and bread quality attributes. This study has identified the need for additional research pertaining to the effect of pea fibre processing on its performance in bread as well as, ways to optimize its performance in bread and other bakery applications. Research gaps to be addressed in order to maximize the use of pea fibre by the bakery industry include:

- Investigating whether the addition of vital wheat gluten would improve the OS and LV in pea fibre enriched breads by counteracting the gluten diluting effect that is occurring,
- Examining if hydrating the fibres for a set period of time before adding them to the dough can decrease the DDT,
- Investigating whether fermenting the fibre enriched doughs for a longer period of time (final proof) increases the OS and LV in the baked bread,
- Exploring other antioxidant assays that will determine the total AOX capacity and bioavailability of pea fibre,
- Investigating the effect of particle size on AOX content of pea fibres, and
- Studying the relationship between soluble fibre and mixing time and between insoluble fibre and mixing tolerance (MTI).

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