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Cereal β-glucans
- functional properties and molecular interactions

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Aim

To provide applicable knowledge on the elemental food functional properties exhibited by barley (Glucagel™) and oat (PromOat™) β-glucan products used as additives in foods.

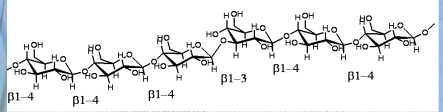
Introduction

Health benefits and functional properties of dietary fibres like mixed linkage (1→3,1→4)-β-D-glucans from cereals make them interesting food constituents. Due to high viscosity and ability to form gels, they are applicable as food hydrocolloids and have been suggested as ingredients in healthy functional foods[1-2].

The effect of hydrocolloids on aroma release from food may be affected by two mechanisms:

I) Physical entrapment
II) Molecular interactions

Both were investigated in our study.



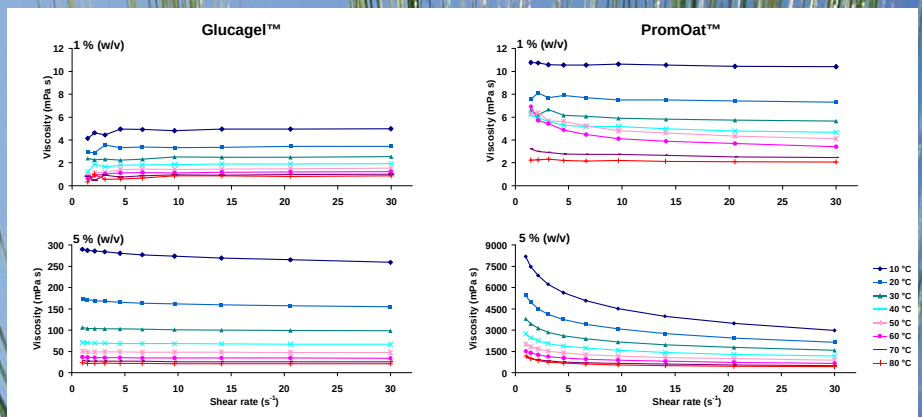
Primary structure of mixed linkage (1→3, 1→4)-β-D-glucan. Structure, size and concentration of the polymer influence the hydrocolloid effect in foods[3].

Product characterisation

The two commercial β-glucan products, Glucagel™ and PromOat™ showed large differences in composition, size and structural characteristics.

	Glucagel™	PromOat™
β-glucan content	80.0% (±8.2)	33.3% (±0.9)
Molecular size	191 kDa	1,120 kDa
β-(1→3) to β-(1→4) ratio	41:59% (±1)	30:70% (±3)

Additional carbohydrate residues (α- and β-glucose and α-dextrins) were identified in both products. PromOat™ being the least purified product.

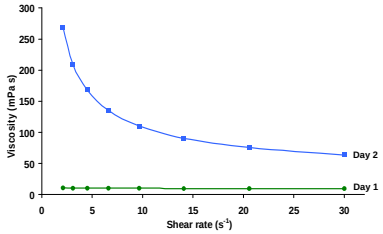


Viscosity of Glucagel™ and PromOat™ solutions determined at 10-80 °C and shear rates 1-30 s^{-1}. Values represent means of two replicates.

Rheology

Viscosity decreased with temperature and increased with concentration for both β-glucan products. Glucagel™ exhibited Newtonian flow behaviour whereas PromOat™ exhibited shear thinning flow behaviour at concentrations >1% (w/v).

The viscosity of a 2.5% Glucagel™ solution at 37°C increased significantly from day 1 to 2. Continuous hydration and network formation of the β-glucan polymers are important aspects in their hydrocolloid functionality as evidenced by the aroma study below.

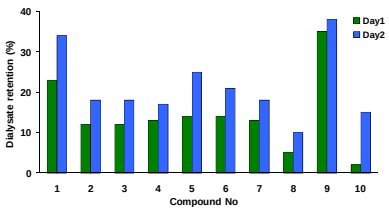


Viscosity of Glucagel™ (2.5% w/v) solution at 37 °C mixed 1 and 2 days prior to measurements. Values represent means of two replicates.

Aroma and dialysis

Glucagel™ showed ability to bind all the aroma compounds tested in a dialysis assay as demonstrated by a general retention of these in the β-glucan matrix. The aroma retention increased from day 1 to day 2.

The different classes of chemical compounds did not differentiate significantly from each other and within the groups with respect to being retained by the β-glucan. Thus, the mode of molecular interaction could not be explained by simple correlation to any physicochemical properties of the aroma compounds.



Percentage dialysate retention from mixed solutions of 2.5 % Glucagel™ and 10 different aroma compounds;

1: 4'-Hydroxy-3'-methoxyacetophenone, **2**: 2,6-Di-tert-butyl-4-methylphenol, **3**: 4-Hydroxy-3-methoxybenzyl alcohol, **4**: 3-Hydroxy-4-methoxybenzyl alcohol, **5**: 3-Ethoxy-4-hydroxybenzaldehyde, **6**: 3,5-Dimethoxyphenol, **7**: 2,5-Dimethylphenol, **8**: Ethyl 4-ethoxy-2-hydroxybenzoate, **9**: 3,5-Dimethoxy-4-hydroxybenzaldehyde, **10**: 4-Hydroxy-3-metoxybenzoic acid

Conclusions

Higher viscosity of PromOat™ compared to Glucagel™ is especially due to longer β-glucan polymers and a higher level of additional carbohydrate residues in this product.

Aroma retention in the Glucagel™ matrix increased with incubation time suggesting tertiary and hygroscopic properties of the β-glucan polymers to be crucial factors in aroma encapsulation.

Based on the above, we have now begun developing a culinary attractive fibre enriched functional food product for testing in a human intervention study.

References

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[3] Papageorgiou, M et al. (2005), J. cereal sci., 42, 213-224.