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Effects of succinylation and deamidation on functional properties of oat protein isolate

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ABSTRACT

The effects of two different modification methods (deamidation and succinylation) on the functional properties (solubility, water- and oil-binding capacity, foaming capacity and stability, emulsion activity and stability) of oat protein isolates were evaluated. Protein isolates extracted from defatted oat flour at alkaline pH were acylated by 0.20 g/g of succinic anhydride. The protein isolate was also modified using a mild acidic treatment (HCl, 0.5 N). Succinylation and deamidation improved solubility and emulsifying activity of the native protein isolate. Foaming capacity of oat protein isolate increased after deamidation, whereas succinylation decreased it. The deamidated and succinylated proteins had lower foam and emulsion stabilities than had their native counterpart. Water- and oil-binding capacity, in both modified oat proteins, was higher than those of the native oat protein isolate.

1. Introduction

Oat is gaining increasing popularity as part of the human diet and is being added, either whole or as fractionated groat, to many food products because of the claims made about its nutritional virtues. Such nutritionally favourable attributes as high protein, fat, and fibre contents have aroused considerable interest in increasing utilisation of oat for human consumption (Lapvetelainen & Aro, 1994). Oat provides a potential source of low-cost proteins with good nutritional value (Ma & Wood, 1987). Protein concentration in oat groats is high, typically ranging from 15% to 20%. Moreover, the nutritional quality of oat protein is fairly good. Lysine, methionine, and threonine are the limiting amino acids although the lysine content in oat is somewhat higher than that in other cereals (Lapvetelainen & Aro, 1994). The use of oats as human and animal food has been justified by its taste and high nutritive value, compared to other cereal grains. The use of oats as human food has also been stimulated by the quality of its fibre components which act as hypoglycemic and/or hypocholesterolemic agents. Protein nutritive value of oats, including protein digestibility in the range of 90.3–94.2%, biological value 74.5–79.6%, net protein utilisation 69.1–72.4 and protein efficiency ratio 2.25–2.38 (Pedo, Sgarbieri, & Gutkoski, 1999), make it suitable for use in human foods. Moreover the protein is well tolerated by adults suffering from coeliac disorders (Ahokas, Heikkila, & Alho, 2005; Thompsom, 2003).

Protein isolates and concentrates prepared from oat have been shown to possess good emulsifying and binding properties (Ma & Khanzada, 1987). However, further improvements in these and other functional properties of oat protein, particularly solubility, which is poor at normal or slightly acidic pH (Ma, 1983), are desirable. In this study, the effects of succinylation and deamidation on the functional properties of oat protein isolates were investigated and compared.

2. Materials and methods

2.1. Materials

Oats were grown in the Lavark experimental field of Isfahan University of Technology. The seeds were dehulled, ground in a disk mill, and defatted by cold extraction with hexane.

2.2. Isolation of oat protein

An isoelectrically precipitated alkaline isolate was prepared by mixing defatted flour with dilute NaOH (0.015 N) at a flour:solvent ratio of 1:8 (w/v) which gave an initial pH of 9.8. The slurry was then stirred at room temperature for 60 min and centrifuged at 3200*g* for 15 min. The supernatant was adjusted to pH 5.7 by 1 N NaOH and then recentrifuged. The resulting pellet was neutralised to pH 6.7–7 and finally freeze-dried (Ma, 1983).

2.3. Deamidation of oat protein

Deamidation of the oat protein isolate was performed using a modified version of the method described by Mimouni, Raymond,

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