Intestinal immunomodulatory effects of a hypoallergenic buckwheat Fag e 1 prepared by Maillard-type glycation with a mannan type-polysaccharide

(Received February 26, 2016)
(Accepted May 7, 2016)

Shigeru Katayama a), Shigeru Tazawa b), Masahiro Kasai a), Takakazu Mitani c), Soichiro Nakamura a, b)

a) Faculty of Agriculture, Shinshu University
b) Interdisciplinary Graduate School of Science and Technology, Shinshu University
c) Institute for Biomedical Science, Shinshu University

Abstract

The 24 kDa protein (Fag e 1) in buckwheat is considered to be one of its major allergens. The purpose of this study is to investigate the immunomodulatory effects of hypoallergenic Fag e 1 prepared by glycation with polysaccharide on mucosal allergenic responses in mice. Mannan-type-polysaccharide such as galactomannan (GalM), konjac glucomannan (KGM), and yeast glucomannan (YGM) showed attenuation of IL-4 and IL-17 production and elevation of IL-10 in cultured Peyer’s patch (PP) cells. The conjugate of Fag e 1 with GalM, KGM, or YGM was prepared using naturally occurring Maillard-type glycosylation. Dietary administration with Fag e 1-YGM conjugate for 8 weeks induced a significant reduction in Fag e 1-specific IgE and IgG1 levels and elevation in IgA level in sera and PP cells. A decrease in IL-4 and IL-17 and increase in IL-10 in PP cells were observed in the group of Fag e 1-YGM conjugate. Differentiation ratio of regulatory T cells (Treg) and T follicular helper cells in PP increased by feeding with Fag e 1-YGM conjugate. These suggest that Fag e 1-YGM conjugate could be contribute to the development of an immunomodulatory hypoallergenic agent for buckwheat allergy.

Keywords: buckwheat, allergy, glycation, immunological tolerance, Treg

I Introduction

Buckwheat (Fagopyrum esculentum) is commonly consumed in Asian countries such as Japan, China, and Korea, and it has recently become more popular in Europe1. Buckwheat has been recognized as a common food allergen and it causes severe anaphylactic reactions by intake of even a small amount of flour or food products made from buckwheat. The prevalence of buckwheat allergy was estimated approximately 3% of all anaphylaxis in Japan2. Among the allergenic proteins in buckwheat, proteins with molecular weight of 9 kDa, 16 kDa, 19 kDa, and 24 kDa are considered major allergens, and 24 kDa and 16 kDa proteins are named as Fag e 1 and Fag e 2, respectively3. Fag e 1 belonging to the β subunit of the legumin-like storage molecule has been reported that the most important allergen responsible for the induction of the immunoglobulin E (IgE)-mediated immediate hypersensitivity reaction in buckwheat allergy6.

Allergen-specific immunotherapy, which entails gradual increasing exposure to allergens in the hopes of desensitization and promoting tolerance, is the most researched approaches to treat allergies5. Currently, oral immunotherapy appears to be a more promising therapeutic approach for food allergies because subcutaneous immunotherapy resulted in unacceptably high rates of severe adverse reactions6. However, there is still the high risk of IgE-mediated side effects, and there is thus a strong need to develop effective and safer tolerogens.

A number of attempts were made to modify allergenic proteins for use in specific immunotherapy. Maillard-type glycosylation has become recognized as effective methods for modification of molecular surface of the target protein. It has been showed that the attachment of polysaccharides