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Recent Challenges for Controlling Food-Borne Pathogens by Modified Seed Proteins

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ABSTRACT

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Introduction

Seeds of plants of family: *Leguminosae* contain a majority of globulins protein (SG) which could be divided into both 11S and 7S globulins subunits. Both native subunits inhibited food-borne pathogens in vitro and in food. The modification of both 11S and 7S globulins by their methylation formulate modified seed globulins (MSG) which are of broader antimicrobial activity than the native forms. Such methylation enables both 11S and 7S globulins subunits to be of net positive charge and of cationic nature which in turn interact with the negatively charged bacterial membranes, resulting in bacterial cell death. There is currently a high incidence of food-borne pathogens in foods; their resistant variants to antimicrobial food additives were isolated and characterized [1]. This clearly showed that there is a need to find out other natural substances to be used as food additives. In this regard natural seed proteins of leguminous plants are used successfully as food additives and showed promising interest to be applicable to increase the shelf life of foods [1-5].

Using such natural seed proteins is promising perspective as it could avoid or limit the use of harmful chemical additives [6]. Seed globulins (SG) constitute most seed proteins within *leguminous* plants; they constitute over 51% of the total seed protein of cowpea, and over 53% of soybean seed protein. SG can be subdivided into two main types according to their sedimentation coefficients: 11S and 7S globulins. The 11S fraction has a molecular mass of 350 kDa and composed of acidic (37–42 kDa) and a basic polypeptide (20 kDa) subunits, linked together by a disulphide bond [7]. The glycinin soybean seed protein subunit inhibited many spoilage bacteria and *Staphylococcus aureus* (VISA) *in vitro* and in food [3]. SG are cationic in nature due to the presence of lysine and arginine residues and, therefore, have a net positive charge. Such cationic nature enables SG to interact with anionic structure of Gram positive and Gram-negative bacterial membranes which are of net negative charge [1,8]. The negatively charged phospholipid of bacterial membranes makes an electrostatic attraction with positively charged SG [2]. SG have a high percent of hydrophobic residues and this hydrophobicity is important in anchoring such protein molecules to the bacterial membranes [9].

SG form amphipathic structure upon interaction with bacterial membranes; this amphipathic nature plays an important role in their binding to bacterial membranes which can be achieved by formation of large number of peptide conformations [10]. Both 11S and 7S globulins subunits of SG were extracted from legume seeds by centrifugation of seed flour, ultracentrifugation, fractionation and reversed phase high performance liquid chromatography [11]. The net positive charge of SG could be increased by methylation of their amino acid residues and in turn increase their antimicrobial activity [6]. Esterification is a successful way to produce modified seed globulins (MSG) with high antimicrobial activity. The previous study [2] found that esterification of SG converts the 7S globulins subunits from native to positively charged while intensifies the positive charge of 11S. This modification eliminates the negative interaction between these two subunits, allowing the MSG to exert broader antimicrobial activity. The preparation and application of

MSG have a great challenge to be used as food additives instead of harmful chemical additives. In addition, the use of MSG as food additives is cheaper than the use of either bacteriocins or other natural substances [12,13].

The MSG showed recent interest to be used as food preservative as their sources are available in Egypt and their non-toxic effect on experimental animals [2]. Those authors found that the methylated soybean protein and methylated chickpea protein showed wider inhibitory spectrum against Listeria monocytogenes and *Salmonella enteritidis* more than that obtained by native ones. The previous study [6] reported a successful use of MSG for food preservation with extended shelf life. Transmission electron microscope (TEM) examination of the MSG-treated bacteria showed the antibacterial action of 11S globulin against *S. typhimurium* and *P. aeruginosa*. MSG was manifested by signs of cellular deformation, partial and complete lysis of cell components [1]. In conclusion, native SG could be transferred to MSG of net positive charge on their both 11S and 7S globulins subunits. This MSG showed no toxicity against experimental animals and showed a distinctive inhibition of pathogenic bacteria *in vitro* and in food. Therefore, MSG could be used as food preservative.

References

1. S Abdel Shafi, AR Al Mohammadi, A Osman, G Enan, S Abdel Hameid, et al. (2019) Biochemical, biological characteristics and antibacterial activity of glycoprotein extracted from the epidermal mucus of African catfish (Clarias gariepinus). Molecules 138: 773-780.
2. M Sitohy, S Mahgoub, A Osman, R El Masry, A Al Gaby (2013) Extent and mode of action of cationic legume proteins against Listeria monocytogenes and Salmonella enteritidis. Probiotics Antimicrob Proteins 5(3): 195-205.
3. A Osman, G Daidamony, M Sitohy, M Khalifa, G Enan (2016) Soybean glycinin basic subunit inhibits methicillin resistant-vancomycin intermediate Staphylococcus aureus (MRSA-VISA) *in vitro*. Int J Appl Res Nat Prod 9: 17-26.
4. S Abdel Shafi, A Osman, G Enan, M El Nemer, M Sitohy (2016) Antibacterial activity of methylated egg white proteins against pathogenic G+ and G– bacteria matching antibiotics. Springer Plus 5(1): 983.
5. G Enan, EM Osman, MEF Abdel Haliem, SE Abdel Ghany (2018) Advances in Microbial and Nucleic Acids Biotechnology. BioMed Research International Article ID 3102374, 2 pages.
6. M Sitohy, A Osman (2018) Bioactive Compounds in Soybean Proteins and Its Applications in Food Systems. In: Sustainability of Agricultural Environment in Egypt: Part I. Springer pp. 147-160.
7. K Liu (2012) Soybeans: Chemistry, Technology, and Utilization. Springer New York, NY, USA.
8. K Lohner (2001) The role of membrane lipid composition in cell targeting of antimicrobial peptides. In: Development of novel antimicrobial agents: Emerging strategies, K Lohner (Ed.), (Norfolk, England: Horizon Scientific Press pp. 149-165.
9. LM Yin, MA Edwards, J Li, CM Yip, CM Deber (2012) Roles of hydrophobicity and charge distribution of cationic antimicrobial peptides in peptide-membrane interactions. J Biol Chem 287(10): 7738-7745.
10. M Fernandez Vidal, S Jayasinghe, AS Ladokhin, SH White (2007) Folding amphipathic helices into membranes: amphiphilicity trumps hydrophobicity. J MolBiol 370(3): 459-470.
11. S Wu, PA Murphy, LA Johnson, AR Fratzke, MA Reuber (1999) Pilot-plant fractionation of soybean glycinin and bconglycinin. J Am Oil Chem Soc 76: 285-293.
12. G Enan, S Abdel Shafi, MEF Abdel Haliem, S Negm (2013) Characterization of probiotic Lactic acid bacteria to be used as starter and protective cultures for dairy fermentation. Int J Probiotics Prebioics 8: 157-164.
13. G Enan, S Abdel Shafi, S Ouda, S Negm (2014) Novel antibacterial activity of Lactococcus lactis subsp. Lactis Z11 isolated from Zabady. Intl J Biomed Sci 9(3): 174-180.

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