

DEVELOPMENT OF NOVEL NATURAL FOOD PRESERVATIVES FROM PHENOLICS OF PEELS OF FIVE  
SELECTED VARIETIES OF POTATO WITH SPECIAL EMPHASIS ON OMEGA-3 FATTY ACIDS  
FORTIFIED FUNCTIONAL FOODS

Abhishek Bhattacharya

[Index No. 53/18/Life Sc./25]

Abstract

Omega-3 fatty acids have immense health benefits. In recent years to increase the nutritional value of foods and reduce the risk of chronic diseases, omega-3 fatty acids enriched oils are added to foods. But developing omega-3 fatty acids fortified stable functional food is challenging because two principal omega-3 fatty acid components eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are highly susceptible to oxidation due to high degree of unsaturation in their molecular structures. Besides, microbial spoilage and contamination of food is another great concern. Although synthetic preservatives are generally used to overcome these problems, they have accumulated evidence that they could be toxic and carcinogenic. Therefore, innovation should continue to seek safe and effective, novel natural food preservatives from other sources especially from plant origin for extending the shelf life of foods especially omega-3 fatty acids fortified functional foods. The use of a combination of preservation factors has been suggested as a viable alternative to synthetic preservatives to preserve food for practical periods of time. Potato peels are rich in phenolic compounds and may serve as a potential source of such compounds due to their strong antioxidant and antimicrobial properties. This work dealt with a detailed and systematic study on evaluation of antioxidant and antimicrobial potential of phenolic extracts of peels of five selected varieties of potato (*Kufri Chipsona-1*, *Kufri Chipsona-3*, *Kufri Chipsona-4*, *Kufri Chandramukhi* and *Kufri Jyoti*) alone and in combination along with chemical characterization of bioactive compounds responsible for antioxidant and antimicrobial action, cytotoxicity evaluation and elucidation of possible modes of antioxidant and antimicrobial interactions with a view to seek safe and effective novel natural promising alternative to synthetic food preservatives for extending the shelf life of foods especially omega-3 fatty acids fortified functional foods. The results revealed that among the peel extracts tested, only peel extracts of *Kufri Chipsona-3*, *Kufri Jyoti* and *Kufri Chandramukhi* potato varieties showed strong antioxidant and antimicrobial activities at their individual effect. In combination, the peel extracts of *Kufri Chipsona-3/Kufri Jyoti* blend showed both synergistic antioxidant and antimicrobial interactions. Chemical analysis revealed that the bioactive compounds responsible for synergistic antioxidant and antimicrobial interactions are prodelphinidin trimer from peel extract of *Kufri Chipsona-3* and 5-Hydroxy-3',4',7-trimethoxyflavone from peel extract of *Kufri Jyoti* potato varieties. These two bioactive compounds in combination did not show any cytotoxic potential at recommended dosage level. At their individual effect, prodelphinidin trimer acts as a primary antioxidant whereas 5-Hydroxy-3',4',7-trimethoxyflavone as a secondary antioxidant (synergist). In combination, 5-Hydroxy-3',4',7-trimethoxyflavone as a secondary antioxidant (synergist) enhanced the antioxidant efficacy of prodelphinidin trimer (primary antioxidant) in oxidative chain reaction by regenerating it which enhanced the net interactive antioxidant effect than the simple sum of their individual effects resulting synergistic antioxidant interaction. The mode of antimicrobial action of prodelphinidin trimer and 5-Hydroxy-3',4',7-trimethoxyflavone at their individual effect against the studied foodborne bacterial pathogens are different. Prodelphinidin trimer at its individual effect, at low concentration functions upon bacterial cell envelope leading to membrane damage and cytoplasm leakage. On the other hand, 5-Hydroxy-3',4',7-trimethoxyflavone at low concentration at its individual effect, did not show any promising activity on cell membrane integrity and cell membrane permeability. Only at high concentration it can destabilize membrane function. In combination, prodelphinidin trimer at low concentration increased membrane permeability of both the studied bacterial pathogens and allows 5-Hydroxy-3',4',7-trimethoxyflavone to enter inside the bacterial cells at its low concentration with ease. Once they entered inside the cell, both the bioactive compounds simultaneously induced a significant disturbance in the cytoplasm of bacterial cells leading to significant release of cytoplasmic materials. At the end, the loss of membrane integrity caused a significant change in cellular morphology which subsequently led to cell lysis and cell death.

Thus, the collective important findings provide evidence that synergistic antioxidant and antimicrobial efficacy of bioactive components prodelphinidin trimer and 5-Hydroxy-3',4',7-trimethoxyflavone in combination without any cytotoxic potential may help in developing a more potent, safe and effective, novel natural alternative to synthetic food preservatives especially for extending the shelf life of omega-3 fatty acids fortified functional foods in food and pharmaceutical industries. This may also be helpful to convert potato peels from waste by-product to value added products.

Abhishek Bhattacharya  
Signature of the candidate 19/09/2022

Rabiranjana Chattopadhyay  
Signature of the supervisor 19/09/2022

Rabi Ranjan Chattopadhyay, Ph.D.  
Professor  
Agricultural and Ecological Research Unit  
Indian Statistical Institute  
203, B. T. Road, Kolkata-700108