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Extended Abstract

Production and Optimization of Functional Fiber Supplement Based on Food By-products Using Extrusion Technology

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Abstract

In this study, the use of extrusion technology in the production of functional fiber supplement from by-products of tomato and rice processing industries (tomato pomace and rice bran) was investigated. A rotatable central composite design was used to investigate the processing and formulation variables including screw speed (120-160 rpm), moisture content (12-18%) and tomato pomace to rice bran ratio (25-75%). The functional and physicochemical properties of texturized products including water absorption index (WAI), swelling (SW), hardness, and soluble dietary fiber content were evaluated. The results showed that WAI of product increased with the increasing of screw speed and tomato pomace to rice bran ratio. Increasing tomato pomace to rice bran ratio and moisture content caused an increase in swelling. The hardness of fiber supplement also increased with increasing tomato pomace to rice bran ratio. Increasing screw speed increased the content of soluble dietary fiber. According to the results, the optimized processing conditions for the production of fiber supplement with desirable properties including WAI (4.64 g/g), SW (4.61 mL/g), hardness (89.08 N) and soluble dietary fiber (11.09%) were as following, moisture content of 14.06%, tomato pomace to rice bran ratio of 26.43% and screw speed of 120 rpm.

Keywords: By-Product, Extrusion, Fiber Supplement, Rice Bran, Tomato Pomace

Introductıon

The presence of dietary fiber in the diet has positive effects on health, which reduces cardiovascular, digestive, blood cholesterol, diabetes and intestinal cancer in people (Yangilar, 2013). In addition to the beneficial effects on health, these compounds have also been widely used in the food industry due to good technological properties such as water absorption, oil absorption and increasing viscosity (Dhingra, 2012). Tomato pomace is a rich source of dietary fiber and protein that is obtained after tomato processing for juice, puree, paste and sauce. Cereal brans, such as rice, is another important source of dietary fiber, which

is commonly found in waste processing of grains. The main methods of stabilization and processing of rice bran with the aim of deactivating enzymes and reducing the amount of phytic acid are heat treatments. In recent years, extrusion technology has been become a unique method for a combination of heat and pressure in a short time in the processing of various types of bran on an industrial scale. Heat-mechanical operations during extrusion cause gelatinization and increasing starch digestibility, denaturation of proteins, increase the amount of soluble dietary fiber, and inactivate undesirable compounds such as enzymes, microorganisms and many anti-nutritional agents (Moscicki & van Zuilichem, 2011). The purpose of this study, is the possibility of using extrusion technology in the production of functional fiber supplement from the mixture of by-products derived from the processing of tomato and rice (tomato pomace and rice bran). Under the condition of the extrusion process and the evaluation of physicochemical and functional properties of the final product, including water absorption index, swelling, hardness and soluble dietary fiber, and the determination of the optimum conditions for the production of functional fiber supplement.

Material and methods

In this study, a rotatable central composite design was used to evaluate the process and formulation variables including screw speed (120-160 rpm), feed moisture content (12-18%) and tomato pomace: rice bran ratio(25: 75-75: 25% w/w). Extrudates were collected and dried in an air-oven at 40 °C for 2 h to obtain a moisture content of 2-3%. The dried samples was ground and passed on sieve with size of 40 mesh. Then, extrudates powders stored in polyethylene bags at 4 °C for further analysis (Selani *et al*., 2014; Potter *et al*., 2013). The functional and physicochemical properties of texturized product including water absorption index (WAI), swelling (SW), hardness, and soluble dietary fiber content were evaluated.

Results and discussion

Investigation of the chemical composition of the raw materials consumed in the fiber supplement formulation showed that the amount of dietary fiber in tomato pomace was higher than rice bran. Figure (1) shows that increasing the screw speed and levels of adding tomato pomace to rice bran increased the water absorption index. Increasing the water absorption index of the samples by increasing the screw speed may be due to the modification of the structure of some tomato pomace components (dietary fiber) by increasing the screw speed. Increasing the water absorption index by increasing the levels of addition of tomato pomace can also be attributed to the higher amount of protein and total dietary fiber in tomato pomace compared to rice bran (Altan *et al*., 2009). The evaluation of the effect of process condition and formulation variables on the swelling of fiber supplementation showed that (Figure 2), increasing the moisture content and tomato pomace to rice bran ratio (due to increasing pectin content and the presence of more amounts of hydrophilic groups as well as the effect of physical properties particle size and porosity in the formulation) linearly increased the amount of swelling of the fiber supplement (Huang & Ma, 2016). Hardness of extrudates ranged from 44 to 151 N. At the highest screw speed (160 rpm), increasing moisture content decreased soluble dietary fiber, but at the highest moisture content, increasing the screw speed increased the amount of soluble dietary fiber (Huang & Ma, 2016; Jing & Chi, 2013; Rashid *et al*., 2015). In this research, the aim of optimization was improvement the functional, physical and nutritional properties of the fiber supplement. According to the results, the optimized processing conditions for the production of fiber supplement with desirable properties including WAI (4.64 g/g), SW (4.61 mL/g), hardness (89.08 N) and soluble dietary fiber (11.09%) were as following, moisture content of 14.06%, tomato pomace to rice bran ratio of 26.43% and screw speed of 120 rpm.

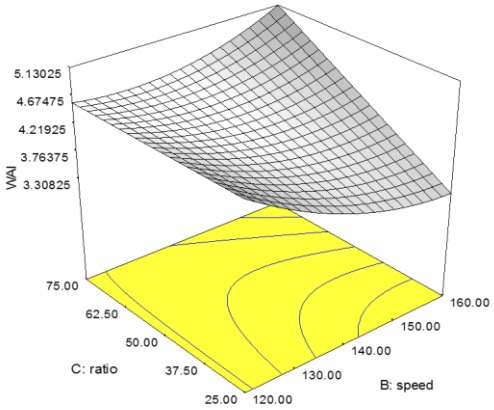

Figure 1. Response surface plot for WAI as a function of pomace level and screw speed at a moisture of 15%

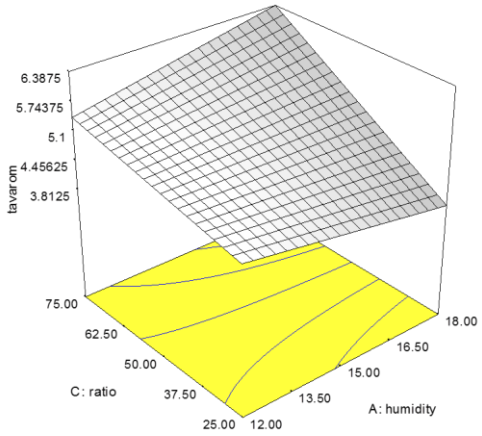

Figure 2. Response surface plot for SW as a function of pomace level and moisture at a screw speed of 140 rpm.

Conclusion

The use of wastes such as tomato pomace and rice bran as a source of dietary fiber along with the richness of proteins, minerals, polyphenols and various types of micronutrients has led to the re-entry of valuable resources into the food cycle and the production of functional products in the Food industry. The results of this study showed the proper function of extrusion process as an effective technology for the modification of physicochemical and functional properties of dietary fiber in the production of a functional fiber supplement from the wastes of the processing industry of tomato and rice (tomato pomace and rice bran). The products, while having the desirable functional properties (high water absorption and high swelling), is rich in soluble dietary fiber and can be used as a formulation component in the formulation of dietary products such as baking, dairy, meat products to improve physicochemical and technological properties of the final product.

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Extended Abstract