MAXIMIZING THE BENEFIT OF SOME FOOD INDUSTRY BY-PRODUCTS USING BIOTECHNOLOGY AND NANO-TECHNOLOGY FOR PRODUCTION OF SOME FUNCTIONAL BAKERY PRODUCTS

By

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B.Sc. Agric. Sci. (Food Technology), Cairo University, 2001
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ABSTRACT

Ayman Abdel Aziz Mohammad. "Maximizing the Benefit of Some Food Industry By-Products Using Biotechnology and Nano-Technology for Production of Some Functional Bakery Products". Unpublished Ph.D. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2016

The aim of this study was to prepare nano and fermented-nano powders of wheat bran, wheat germ, rice bran, carrot pomace and pomegranate peels by superfine grinding of raw and fermented materials. Physico-chemical and functional properties as well as phenolic acids profiles of raw and prepared materials were evaluated. In addition, prepared extracts were used to evaluate the phytochemical contents, antioxidant activity and cytotoxic activity of the prepared materials. Moreover, wheat flour (72%) was substituted with nano wheat bran, nano wheat germ, fermented-nano rice bran, fermented-nano carrot pomace and fermented-nano pomegranate peel at the levels of 5, 15 and 25% to prepare functional formulas. Rheological properties of these formulas were investigated using the Mixolab compared to wheat flour 72%, wheat flour 82% and whole-meal flour as control samples. Also, the prepared formulas were used to manufacture functional pan and balady breads and the quality characteristics of produced bread were evaluated.

The results showed that superfine grinding could effectively pulverize the fiber particles to nano-scale. Chemical analysis revealed higher protein in wheat germ, higher fat and ash in rice bran and higher fiber in pomegranate peels. Color investigation showed higher lightness value (74.02) for wheat bran, higher redness value (14.24) for pomegranate peels and higher yellowness value (32.53) for wheat germ. Carrot pomace had the highest water holding capacity (7.49 g/g), as well as swelling capacity (6.12 ml/g). As particle size decrease, the functional properties were significantly ($p<0.05$) affected. The water and oil holding capacity decreased, while swelling capacity, water solubility index and emulsifying activity increased. Phenolic acids profiles of WB, WG and RB was nearly similar and ferulic acid dominated these profiles. Most of

phenolic acids in these materials were bound. While, the majority of phenolic acids in CP were found to be free. Gallic and protochatchuic acids dominated the phenolic acids in CP. Each gram of PP contained 851.48, 274.68 and 1744.69 µg free, conjugated and bound phenolic acids, respectively. Gallic acid dominated the free and bound forms, while catachine dominated the conjugated form. Ultrafine grinding and fermentation apparently increased the free, conjugated and bound forms of most identified phenolic acids.

The results of antioxidants analysis (phenols, flavonoids and carotenoids) and antioxidant activity conducted on successive extracts showed that ultrafine grinding did not significantly affect these parameters in WB, WG, RB or CP. Only antioxidants and antioxidant activity of NPP significantly increased. Also, fermentation process did not significantly alter these parameters in WB, WG or RB, while antioxidants and antioxidant activity of FNCP and FNPP significantly increased. Cytotoxic activity of the prepared extracts from ultrafine ground samples against cancer cell growth increased compared to raw materials. For instance, IC_{50} value of NPP extract decreased to 1.64 mg/ml. Also, the extracts of fermented-nano materials showed lower IC_{50} values compared to the extracts of raw and nano forms which indicated that fermentation process increased the anticancer activity of tested materials. The highest effect of fermentation process on the anticancer activity was in FNCP.

Fibers improved the nutritional value of bread but altered the rheological properties of dough, the quality and sensory properties of the final bread product. Regarding the obtained results functional bread suitable for cancer patients could be produced using wheat flour incorporated NWB up to 25%, NWG and FNRB up to 15% and FNCP and FNPP up to 5% with longer shelf life than control samples

Key words: Food by-products, biotechnology, nanotechnology, functional properties, antioxidant activity, anticancer activity, rheological properties and bread.

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