

**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

M.Sc. Agric. Sci. (Food Technology), Cairo University, 2010

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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 Unpublished Ph.D. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2016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 protocatechuic 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 catechine 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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CONTENTS

LIST OF TABLES.....	vi
LIST OF FIGURES.....	viii
LIST OF ABBREVIATIONS.....	x
1. INTRODUCTION.....	1
2. REVIEW OF LITERATURE.....	5
2.1. Functional foods	5
2.1.1. Prebiotics.....	7
2.1.2. Bioactive phytochemicals and functional foods	8
2.2. Comparative evaluation of antioxidant activity assay.....	10
2.2.1. Radical ABTS scavenging activity	12
2.2.2. Radical DPPH scavenging activity	12
2.2.3. Ferric reducing antioxidant power assay (FRAP).....	13
2.3. Food by-products as potential natural sources of prebiotics and antioxidants	13
2.3.1. Cereal by-products as a source of antioxidants	14
2.3.2. Carrot pomace as a source of antioxidants	19
2.3.3. Pomegranate peels as a source of antioxidants.....	20
2.4. Antioxidants: their role in disease prevention.....	23
2.4.1. Anticancer potential of phytochemicals	24
2.4.1.1. Anticancer activity of wheat bran.....	26
2.4.1.2. Anticancer activity of wheat germ.....	27
2.4.1.3. Anticancer activity of rice bran.....	28
2.4.1.4. Anticancer activity of carrot pomace.....	30
2.4.1.5. Anticancer activity of pomegranate peel.....	31
2.5. Challenges facing use of food by-products.....	32
2.5.1. Solid-state fermentation of by-products.....	33
2.5.2. Ultrafine grinding of by-products.....	36
2.6. Rheological properties of wheat flour containing antioxidant sources.....	39
2.7. Application of food by-products in functional bakery	

products.....	45
3. MATERIALS and METHODS.....	49
3.1. MATERIALS.....	49
3.1.1. Wheat flours, wheat bran and wheat germ	49
3.1.2. Rice bran	49
3.1.3. Carrot and pomegranate	49
3.1.4. Yeast and other baking ingredients.....	49
3.1.5. Phenolic acids standards.....	49
3.1.6. Radical precursor and folin.....	49
3.1.7. Solvents and other chemicals.....	50
3.2. METHODS	50
3.2.1. Preparation of raw materials	50
3.2.1.1. Stabilization of wheat germ and rice bran.....	50
3.2.1.2. Preparation of carrot pomace.....	50
3.2.1.3. Preparation of pomegranate peel.....	51
3.2.2. Solid-state yeast fermentation	51
3.2.3. Preparation of nano and fermented-nano materials...	52
3.2.4. Physico-chemical analysis	52
3.2.4.1. Transmission Electron Microscopy	52
3.2.4.2. Color measurements	52
3.2.4.3. Chemical composition.....	52
3.2.5. Functional properties	53
3.2.5.1. Water holding capacity	53
3.2.5.2. Swelling capacity	53
3.2.5.3. Water solubility index.....	53
3.2.5.4. Oil holding capacity.....	54
3.2.5.5. Emulsifying activity and emulsion stability.....	54
3.2.6. Determination of phenolic acids profile.....	55
3.2.6.1. Free phenolic acids.....	55
3.2.6.2. Conjugated phenolic acids.....	55
3.2.6.3. Bound phenolic acids.....	56
3.2.6.4. HPLC analysis of phenolic acids.....	56

3.2.7. Preparation of successive extracts molasses	57
3.2.8. Determination of major phytochemicals in prepared extracts.....	57
3.2.8.1. Determination of total phenolic content.....	57
3.2.8.2. Determination of total flavonoid content.....	58
3.2.8.3. Determination of total carotenoids	58
3.2.9. Determination of antioxidant activity of prepared extracts.....	59
3.2.9.1. Determination of radical DPPH scavenging activity..	59
3.2.9.2. Determination of radical ABTS scavenging activity..	59
3.2.9.3. Ferric reducing activity power (FRAP) assay.....	60
3.2.10. Cytotoxic effect of prepared extracts on human cell line (HCT 116).....	60
3.2.11. Preparation of functional formulas	61
3.2.12. Mixolab properties of prepared formulas	62
3.2.13. Processing of pan bread	64
3.2.14. Processing of balady bread.....	65
3.2.15. Physical measurements of pan bread.....	65
3.2.16. Sensory evaluation of bread.....	66
3.2.16.1. Sensory evaluation of pan bread	66
3.2.16.2. Sensory evaluation of balady bread.....	66
3.2.17. Texture properties of bread crumb	66
3.2.18. Freshness of pan and balady bread.....	68
3.19. Statistical analysis.....	69
4. RESULTS and DISCUSSION.....	70
4.1. Particle size analysis.....	70
4.2. Chemical composition of raw materials as affected by fermentation and ultrafine grinding	72
4.3. Color quality as affected by fermentation and ultrafine grinding.....	74
4.4. Functional properties as affected by fermentation and ultrafine grinding	77
4.4.1. Hydration properties	77

4.4.2. Water solubility index (WSI).....	80
4.4.3. Oil-holding capacity	82
4.4.4. Emulsifying properties.....	83
4.5. Phenolic acids profiles of raw, nano and fermented-nano materials.....	85
4.5.1. Phenolic acids profiles of cereal by-products.....	85
4.5.2. Phenolic acids profiles of carrot pomace.....	94
4.5.3. Phenolic acids profiles of pomegranate peels.....	97
4.6. Successive extraction yields of raw, nano and fermented-nano materials.....	100
4.7. Phytochemical analysis.....	102
4.7.1. Total phenolic content.....	102
4.7.2. Total flavonoids content.....	104
4.7.3. Total carotenoids content.....	104
4.8. Antioxidant activity of raw, nano and fermented-nano materials.....	106
4.8.1. DPPH radical scavenging activity.....	106
4.8.2. ABTS radical scavenging activity.....	107
4.8.3. Ferric ions reducing antioxidant power assay	109
4.9. Cytotoxic activity of raw, nano and fermented-nano materials	110
4.10. Correlation between antioxidants, antioxidant activity and cytotoxic activity of raw, nano and fermented-nano materials.....	112
4.11. Rheological properties of formulated dough.....	114
4.11.1. Mixing properties of wheat flour dough as affected by addition of nano and fermented-nano materials.....	114
4.11.2. Pasting behavior of wheat flour dough as affected by addition of nano and fermented-nano materials.....	121
4.11.3. Mixolab profiles of wheat flour dough as affected by addition of nano and fermented-nano materials.....	124
4.12. Production of functional bread.....	127
4.12.1. Production of pan bread	127

4.12.1.1. Physical measurements of pan bread as affected by addition of nano and fermented-nano materials ...	127
4.12.1.2. Organoleptic characteristics of pan bread as affected by addition of nano and fermented-nano materials.....	130
4.12.1.3. Texture profile analysis of pan bread as affected by addition of nano and fermented-nano materials....	132
4.12.1.4. Color properties of pan bread as affected by addition of nano and fermented-nano materials.....	138
4.12.2.3. Freshness properties of pan bread as affected by addition of nano and fermented-nano materials....	142
4.12.2. Production of balady bread	146
4.12.2.1. Organoleptic characteristics of balady bread as affected by addition of nano and fermented-nano materials.....	147
4.12.2.2. Color properties of control and functional balady bread.....	150
4.12.2.3. Freshness properties of balady bread as affected by addition of nano and fermented-nano materials....	153
5. SUMMARY AND CONCLUSION.....	157
6. REFERENCES.....	170
7. ARABIC SUMMARY.....	--

LIST OF TABLES

No	TITLE	Page
1	Prominent types of functional food	6
2	Proximate chemical composition of raw, nano and fermented-nano-materials.....	73
3	Color attributes of raw, nano and fermented-nano materials.....	76
4	Phenolic acids profile of raw, nano and fermented-nano wheat bran.....	88
5	Phenolic acids profile of raw, nano and fermented-nano wheat germ.....	90
6	Phenolic acids profile of raw, nano and fermented-nano rice bran.....	92
7	Phenolic acids profile of raw, nano and fermented-nano carrot pomace.....	95
8	Phenolic acids profile of raw, nano and fermented-nano pomegranate peels.....	98
9	Phytochemicals of raw, nano and fermented-nano-materials	105
10	Antioxidant activity of raw, nano and fermented-nano-materials.....	108
11	Cytotoxic activity of raw, nano and nano-fermented materials	111
12	Correlation coefficient of antioxidants, antioxidant activity and cytotoxic activity of raw, nano and fermented-nano materials.....	113
13	Mixing properties of wheat flour dough as affected by addition of nano and fermented-nano materials.....	116
14	Pasting behavior of wheat flour dough as affected by addition of nano and fermented-nano materials.....	123
15	Mixolab profiles of wheat flour dough as affected by addition of nano and fermented-nano materials.....	125
16	Baking quality of pan bread as affected by addition of nano and fermented-nano materials	128

17	Organoleptic characteristics of pan bread as affected by addition of nano and fermented-nano materials	131
18	Texture profile parameters of pan bread as affected by addition of nano and fermented-nano materials	133
19	Color attributes of pan bread crust as affected by addition of nano and fermented-nano materials.....	140
20	Color attributes of pan bread crumb as affected by addition of nano and fermented-nano materials.....	141
21	Alkaline water retention capacity of pan bread as affected by addition of nano and fermented-nano materials.....	144
22	Organoleptic characteristics of balady bread as affected by addition of nano and fermented-nano materials.....	148
23	Color attributes of balady bread crust as affected by addition of nano and fermented-nano materials.....	151
24	Color attributes of balady bread crumb as affected by addition of nano and fermented-nano materials.....	152
25	Alkaline water retention capacity of balady bread as affected by addition of nano and fermented-nano materials.....	155

LIST OF FIGURES

No	TITLE	Page
1	Examples of naturally occurring phenolic acids	9
2	Examples of naturally occurring flavonoids	10
3	Polyphenol-protein complex formation.....	40
4	Preparation of raw materials	51
5	Phenolic acid extraction procedure	56
6	Description of a typical curve obtained from the Mixolab	64
7	Calculations of texture profile analysis.....	67
8	Transmission electron micrographs of, nano and fermented-nano powder	71
9	Hydration properties of raw, nano and fermented-nano materials	78
10	Water solubility index of raw, nano and fermented-nano materials.....	81
11	Oil-holding capacity of raw, nano and fermented-nano materials.....	82
12	Emulsifying properties of raw, nano and fermented-nano materials.....	84
13	HPLC chromatograms of typical fractions of wheat bran.	89
14	HPLC chromatograms of typical fractions of wheat germ	91
15	HPLC chromatograms of typical fractions of rice bran....	93
16	HPLC chromatograms of typical fractions of carrot pomace.....	96
17	HPLC chromatograms of typical fractions of pomegranate peels.....	99
18	Successive extraction yield of raw, nano and fermented- nano materials	102
19	Mixograms of wheat flours (left) and wheat flour incorporated with nano wheat bran (NWB) (right)	118

20	Mixograms of wheat flour 72% incorporated with nano wheat germ (NWG) (left) and fermented-nano rice bran (FNRB) (right).....	119
21	Mixograms of wheat flour 72% incorporated with fermented-nano carrot pomace (FNCP) (left) and fermented-nano pomegranate peel (FNPP) (right).....	120
22	Mixogram profiles of wheat flour dough as affected by addition of nano and fermented-nano materials	126
23	Photographs of pan bread as affected by addition of nano and fermented-nano materials.....	129
24	Texture profiles of pan bread made from wheat flour with different extraction (left) and wheat flour 72% incorporated nano wheat bran (NWB) (right).....	134
25	Texture profiles of pan bread made from wheat flour 72% incorporated nano wheat germ (NWG) (left) and fermented-nano rice bran (FNRB) (right).....	135
26	Texture profiles of pan bread made from wheat flour 72% incorporated fermented-nano carrot pomace (FNCP) (left) and fermented-nano pomegranate peel (FNPP) (right).....	136
27	Loss of freshness in pan bread during storage as affected by addition of nano and fermented-nano materials.....	145
28	Photographs of balady bread as affected by addition of nano and fermented-nano materials	149
29	Loss of freshness in balady bread during storage as affected by addition of nano and fermented-nano materials	156