

UTILIZATION OF SOME CEREALS IN PRODUCTION OF FERMENTED FUNCTIONAL FOODS

By

SALMA MOHAMED ISMAIL ABD-ELLATIF

B.Sc. Agric. Sc. (Food Science), Cairo University, 2013

A Thesis Submitted in Partial Fulfillment

Of

the Requirements for The Degree of

MASTER OF SCIENCE

in

Agricultural Sciences

(Food Science and Technology)

Department of Food Science

Faculty of Agriculture

Ain Shams University

2019

Approval Sheet

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This thesis for M.Sc. degree has been approved by:

Dr. Wael Ahmed Bazaraa

Prof. of Food Science and Technology, Faculty of Agriculture,
Cairo University.

Dr. Yehia Abdel-Razik Heikal

Prof. Emeritus of Food Science and Technology, Faculty of
Agriculture, Ain Shams University.

Dr. Nagwa Mousa Hassan Rasmy

Prof. Emeritus of Food Science and Technology, Faculty of
Agriculture, Ain Shams University.

Dr. Ibrahim Rizk Sayed Ahmed Rizk

Prof. Emeritus of Food Science and Technology, Faculty of
Agriculture, Ain Shams University.

Date of Examination: 20 / 2 / 2019

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SALMA MOHAMED ISMAIL ABD-ELLATIF

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Under the supervision of:

Dr. Ibrahim Rizk Sayed Ahmed Rizk

Prof. Emeritus of Food Science and Technology, Food Science
Department, Faculty of Agriculture, Ain Shams University.
(Principal supervisor)

Dr. Nagwa Mousa Hassan Rasmy

Prof. Emeritus of Food Science and Technology, Food Science
Department, Faculty of Agriculture, Ain Shams University.

Dr. Samar Mohamed Mahdy

Lecturer of Food Science and Technology, Food Science
Department, Faculty of Agriculture, Ain Shams University.

ABSTRACT

Salma Mohamed Ismail Abd-Ellatif: Utilization of some Cereals in Production of Fermented Functional Foods. Unpublished M.Sc. Thesis, Department of Food Science, Faculty of Agriculture, Ain Shams University, 2019.

Cereal grains can be used as suitable substrates or carriers for probiotic bacteria (Lactic acid bacteria (LAB) or bifidobacteria) to prepare new fermented functional products.

The present study was carried out to manufacture and evaluate some fermented functional cereal products (cereal-based fermented beverages and tarhana) by the utilization of starter cultures of probiotics in the fermentation of whole grains meal of wheat, oat flakes and barley. The effect of different fermentation parameters on the microbiological and sensory properties of the fermented products were studied.

The proximate chemical composition of cereal grains showed that oat flakes meal had the highest amount of lipids (8.25 %), ash (4.10%) and crude fibers (3.70%), while whole barley meal contained the highest amount of crude proteins (13.75%) and total phenolic compounds (2.72 mg gallic acid/g).

The effect of different fermentation parameters on the microbial population, pH values and titratable acidity of oat and barley beverages (Ob and Bb) were determined during 24 h of fermentation at 37°C with *Lactobacillus plantarum* (EMCC 1039), *Lactobacillus acidophilus* LA-5 (DSM 13241) and *Bifidobacterium lactis* Bb-12 (DSM 15954). Fermentation of cereal beverages at different concentrations (2.0, 3.5 and 5.0%) showed that the population densities of pure bacterial cultures ranged between 10^7 - 10^8 cfu/ml at 24 h. Different Bb samples showed higher decrease in pH values and an increase in titratable acidity (TA) than Ob samples. In order to obtain good consistency, cereal beverages at 3.5% were chosen.

When mixed bacterial cultures were applied, the highest cell count was registered for *L. plantarum* with either *L. acidophilus* or *B. lactis* and the combination of three cultures. The maximum concentration of lactic acid observed in Bb fermented with *L. plantarum* and *L. acidophilus* (1.32 g lactic acid/L) was lower than that fermented with single culture (1.4 g lactic acid/L). Fermentation of mixed oat-barley beverage (OBb) with pure or mixed bacterial cultures showed a considerable difference in cell population, pH and acid production. Different tested pure or mixed cultures showed good growth in mixed cereal media than in single media. Cereal beverages supplemented with 4.0% sucrose, 0.2% inulin and 0.5% whey protein concentrate showed rapid decrease in pH values (3.3) and an increase of cell counts (10^9 cfu/ml) and titratable acidity (1.4 to 1.6 g lactic acid/L) after 10 h of fermentation. Sensory analysis showed that fermentation of single or mixed cereal beverages with probiotic bacteria significantly ($p \leq 0.05$) enhanced the overall acceptability and flavor compared with unfermented beverages. Moreover, the microbial count of these beverages remained stable (above 10^8 cfu/ml) during 21 days of storage at 4°C.

The effect of substituting wheat flour 72% (WF) with different ratios of whole wheat meal (WWM), oat flakes meal (OFM), whole barley meal (WBM) and mixed-cereal meal (OFM& WBM) on functional, rheological, color and sensorial properties of tarhana samples was determined. pH values of tarhana samples were reduced from 5.22-5.89 to 4.81-5.09 after 72 h of fermentation. The flow behavior index of tarhana soup samples ranged between 0.11 to 0.19, indicating the pseudoplasticity of tarhana samples. The higher value of consistency coefficient was recorded for OFM 50% sample followed by WWM 100% sample. Fermentation loss values of tarhana samples ranged between 7.12% for OFM 25% sample and 12.61% for mixed-cereal 50% sample.

Substitution of WF in tarhana formulation with whole cereal grains meal reduced the yellowness of tarhana samples. The addition of different

whole cereal grains meal significantly ($p \leq 0.05$) improved water and oil absorption capacity of tarhana samples. Also, partial substitution of WF with OFM and mixed-cereal meal at ratio of 50% in tarhana recipe has significantly ($p \leq 0.05$) increased foaming capacity and stability of the final product. The highest values of sensory parameters were scored for Tarhana samples prepared with OFM at ratios of 25 and 50%, mixed-cereals meal at 50% and the control sample.

According to the results of this study, it is possible to develop acceptable fermented functional cereal-based products in attempt to have a product combining the nutritional value of whole cereal grains and the health benefits of probiotics.

Key words: Whole Cereal grains, Probiotics, Lactic acid bacteria, Functional foods, Dietary fibers, Cereal-based beverages, Tarhana, Rheology, Sensory, Functional properties

ACKNOWLEDGMENT

All praise is due to **Allah**, who guided me to this step, seeking his forgiveness for any shortcoming.

I wish to express my thanks to **Prof. Dr. Ibrahim Rizk Sayed Ahmed**, Professor of Food Science and Technology, Food Science Department, Faculty of Agriculture, Ain Shams University, for his appreciated efforts in supervising this work, fruitful advices and continuous help that he offered throughout this work.

Words cannot be enough to express my deepest appreciation and sincere gratitude to **Prof. Dr. Nagwa Mousa Hassan Rasmy**, Professor of Food Science and Technology, Food Science Department, Faculty of Agriculture, Ain Shams University, for the continuous support, great and sincere guidance and advices. She has taught me more than I could ever give her credit for here.

I would like to thank **Dr. Samar Mohamed Mahdy**, Lecturer of Food Science and Technology, Food Science Department, Faculty of Agriculture, Ain Shams University, for her efforts throughout the lab work and help in technical and statistical issues.

Thanks also goes to **Dr. Marwa Mohamed Al-Moghazy**, Researcher at National Research Center, for her notable assistance during the study.

Special thanks to all my professors and colleagues of Food Science Department, Faculty of Agriculture, Ain Shams University, for their kind help and encouragement.

Thanks and gratefulness will not be enough to my family for their continuous support and help.

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