



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



MONA MAGHRABY

QUALITY OF SOME BAKERY PRODUCTS AND ITS RELATION TO ENZYME ACTIVITY

By

EMAN KAMAL NABIH HANAFI

B.Sc. Agric. Sci. (Food Technology), Ain Shams Univ., 2008

M.Sc. Agric. Sci. (Food Science and Technology), Ain Shams Univ., 2014

**A Thesis Submitted in Partial Fulfillment
Of
The Requirements for the Degree of**

**DOCTOR OF PHILOSOPHY
in
Agricultural Sciences
(Food Science and Technology)**

**Department of Food Science
Faculty of Agriculture
Ain Shams University**

2020

Approval Sheet

QUALITY OF SOME BAKERY PRODUCTS AND ITS RELATION TO ENZYME ACTIVITY

By

EMAN KAMAL NABIH HANAFI

B.Sc. Agric. Sci. (Food Technology), Ain Shams Univ., 2008

M.Sc. Agric. Sci. (Food Science and Technology), Ain Shams Univ., 2014

This thesis for Ph.D. degree has been approved by:

Dr. Ahmed Ibrahim El-Desouky Abdelhamid

Prof. and Head of Food Technology Dept., Faculty of
Agriculture, Benha University.

Dr. Ibrahim Rizk Sayed Ahmed Rizk

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

Dr. El-Sayed Ibrahim Yousif Abou Elsoud

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

Dr. Magdy Gomaha El-Shemy

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

Date of Examination: 28 / 7 / 2020

QUALITY OF SOME BAKERY PRODUCTS AND ITS RELATION TO ENZYME ACTIVITY

By

EMAN KAMAL NABIH HANAFI

B.Sc. Agric. Sci. (Food Technology), Ain Shams Univ., 2008

M.Sc. Agric. Sci. (Food Science and Technology), Ain Shams Univ., 2014

Under the supervision of:

Dr. Magdy Gomaha El-Shemy

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

Dr. El-Sayed Ibrahim Yousif Abou Elsoud

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

Dr. Nessrien Mohamed Nabih Yasin

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

ABSTRACT

Eman Kamal Nabih Hanafi: Quality of some Bakery Products and its Relation to Enzyme Activity. Unpublished Ph. D. Thesis, Department of Food Science and Technology, Faculty of Agriculture, Ain Shams University, 2020.

This study was to investigate the relationship between the enzymatic activity and the quality characteristics of both pan bread made by frozen dough which was prepared from different wheat flours (72 % ext.), as well as balady bread produced using wheat flour with 82% ext. and its blends with malt flour (MF) as dough improver at 1 and 2% levels.

Various physicochemical and rheological properties of flours were studied. α -amylase and xylanase activities were estimated for flour, dough and various produced breads. Thermal properties of pan bread doughs were measured from its freezing curves. The effect of storage at $-18\pm 2^{\circ}\text{C}$ for 70 days on the fermentation activity of pan bread doughs was monitored. Specific volume and crust color were evaluated after 1 h of pan bread baking. The baking characteristics for different balady breads were determined. Staling rates were calculated over 72 h of bread storage at $25\pm 2^{\circ}\text{C}$. Sensory evaluation for the produced breads was also performed.

Data revealed that, the physicochemical parameters and the rheological characteristics were highly affected by the wheat variety and the extraction rate. Moreover, flour samples were significantly ($p\leq 0.05$) differed in their α -amylase and xylanase activities. Dough samples had higher enzyme activity compared to the wheat flours from which they were made. Using compressed yeast in the preparation of pan bread doughs resulted in a considerable decline of freezing point (t_f). The end freezing point (t_e) ranged from -16°C to -9°C . A significant ($p\leq 0.05$) increase in α -amylase activity was recorded by extending the frozen storage period of dough up to 70 days at $-18\pm 2^{\circ}\text{C}$, which was in consistent with the changes of pH values, while it declined significantly ($P\leq 0.05$) after bread baking.

Xylanase activity significantly ($p \leq 0.05$) increased during the first 14 days of frozen storage of the dough, then decreased gradually till the end of frozen storage period. Also, xylanase activity has the same behavior as α -amylase in pan breads. The longer the frozen storage time of dough at $-18 \pm 2^\circ\text{C}$, the higher decreasing in the residual enzymatic activity of pan breads. However, enzyme activities in the doughs and pan breads strongly depended on the flour and yeast types. Pan breads prepared from doughs with a high α -amylase activity had better specific volumes, crust color, crumb texture and overall acceptability. Moreover, with increasing the time of frozen storage of dough at $-18 \pm 2^\circ\text{C}$, there was a decrease on the fermentation activity, thus caused a reduction in specific volume. Pan breads obtained from the frozen doughs presented significantly ($p \leq 0.05$) lower L^* and b^* values, while higher a^* values than breads obtained from unfrozen doughs. Weight loss and staling rates gradually increased during 72 h of bread storage at $25 \pm 2^\circ\text{C}$.

On the other hand, the addition of MF to 82% ext. wheat flour significantly ($p \leq 0.05$) influenced protein and wet gluten contents, as well as GI, FN, LN and water hydration properties. This effect was extremely dependent on the level of MF adding. Using MF in the preparation of balady bread dough significantly ($p \leq 0.05$) increased the weight, diameter and moisture content of produced breads, as well as produced breads with better appearance, crust color, crumb texture, odor, taste and water retention than control bread. Meanwhile, with increasing the storage time of all balady breads up to 72 h at $25 \pm 2^\circ\text{C}$, the alkaline water retention capacity and penetration unit values were significantly ($p \leq 0.05$) reduced. Such decrease was faster in control bread compared to those prepared using MF. After 72 h of storage, bread samples prepared using MF significantly ($p \leq 0.05$) had lower staling rates than control balady bread.

In conclusion, the quality characteristics of pan bread produced from frozen dough strongly affected by flour and yeast types, and the time of frozen storage of dough. Also, MF could be suggested as a dough improver for producing balady bread with high quality characteristics.

Key words: Wheat flour, Physicochemical properties, Rheological properties, Frozen dough, Freezing curve, α -amylase, Xylanase, Fermentation activity, Pan bread, Specific volume, Malt flour, Balady bread, Staling, Sensory evaluation.

ACKNOWLEDGMENT

All praises are due to Allah who blessed me with kind professors and colleagues and gave me the support to finish this thesis.

I wish to extend my deepest appreciation and sincere gratitude to **Prof. Dr. Magdy G. El-Shemy**, Professor Emeritus of Food Science and Technology, Food Sci. Dept., Fac. of Agric., Ain Shams Univ. for his kind attention and greater help provided for the accomplishment of this work and for his efforts, supervising the research and writing the manuscript. It is difficult to express in words my deep respect for him.

Thanks and gratefulness will not be enough to **Prof. Dr. El-Sayed I. Y. Abou Elsoud**, Professor Emeritus of Food Science and Technology, Food Sci. Dept., Fac. of Agric., Ain Shams Univ. for his kind supervision, valuable guidance, plentiful advice and, endless efforts that have been provided to me to accomplish this work.

Deepest thanks to **Prof. Dr. Nessrien M. N. Yasin**, Professor of Food Science and Technology, Food Sci. Dept., Fac. of Agric., Ain Shams Univ. for her kind encouragement and continuous support to me, and her tangible efforts throughout the lab work and writing the manuscript.

I would like to express my profound and sincere gratitude to **Prof. Dr. Gamal A. El-Shatanovi**, Professor of Food Science and Technology, Food Sci. Dept., Fac. of Agric., Ain Shams Univ. God bless his soul.

Deep gratitude is also extended to **Prof. Dr. Yehia A. Heikel**, Professor Emeritus of Food Science and Technology, Food Sci. Dept., Fac. of Agric., Ain Shams Univ. for his continuous support in this work.

My sincere thanks and gratitude to all staff members of Food Sci. Dept., Fac. of Agric., Ain Shams Univ. for their fruitful help and support.

Finally, warm thanks will not be enough to my family for their sincere support and continuous encouragement.

CONTENTS

	Page
LIST OF TABLES	V
LIST OF FIGURES	VIII
LIST OF ABBREVIATIONS	IX
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	5
2.1. Overview of wheat grains and its physicochemical characteristics.	5
2.2. Physicochemical properties of wheat flour.	8
2.2.1. Proximate chemical composition.	8
2.2.2. Gluten characteristics.	9
2.2.3. Starch characteristics.	10
2.2.3.1. Falling number.	11
2.2.3.2. Damaged starch level.	11
2.2.4. Color attributes.	12
2.3. Rheological characteristics of wheat flour.	14
2.4. Role of enzymes in bread baking.	16
2.4.1. Alpha-amylase.	16
2.4.2. Xylanase.	18
2.5. An overview of frozen dough and its quality.	20
2.6. Quality attributes of bread.	21
3. MATERIALS AND METHODS	25
3.1. MATERIALS	25
3.1.1. Wheat varieties.	25
3.1.2. Wheat flours.	25
3.1.3. Baking ingredients.	25
3.1.4. Chemicals.	25
3.1.5. Culture media.	25
3.2. METHODS	25
3.2.1. Technological methods.	25
3.2.1.1. Milling of wheat grains.	25

II

3.2.1.2. Pan bread processing	26
3.2.1.2.1. Preparation of frozen dough.	26
3.2.1.2.2. Pan bread making.	26
3.2.1.3. Preparation of malt flour.	27
3.2.1.4. Balady bread processing.	27
3.2.2. Analytical methods.	28
3.2.2.1. Test weight.	28
3.2.2.2. Thousand-kernel weight (TKW).	28
3.2.2.3. Proximate chemical composition.	28
3.2.2.4. Gluten content.	28
3.2.2.5. Sedimentation test.	18
3.2.2.6. Falling Number (FN).	29
3.2.2.7. Damaged starch (DS).	29
3.2.2.8. Color measurements.	29
3.2.2.9. Rheological properties of wheat flours.	29
3.2.2.9.1. Water hydration properties.	29
3.2.2.9.2. Farinograph test.	30
3.2.2.9.3. Extensograph test.	30
3.2.2.10. Enzymatic activity measurements.	30
3.2.2.10.1. α -amylase activity.	30
3.2.2.10.2. Xylanase activity.	30
3.2.2.11. Thermal properties of pan bread doughs during freezing.	31
3.2.2.12. Determination of pH values.	31
3.2.2.13. Fermentation activity of pan bread doughs.	31
3.2.2.13.1. Yeast survival counts.	31
3.2.2.13.2. Dough specific volume.	32
3.2.2.13.3. Gassing power.	32
3.2.2.14. Dough and bread yields.	32
3.2.2.15. Specific volume of pan bread.	32
3.2.2.16. Determination of titratable acidity (TTA).	32
3.2.2.17. Baking characteristics of balady bread.	33
3.2.2.18. Sensory evaluation of breads.	33
3.2.2.18.1. Sensory evaluation of pan bread.	33

III

3.2.2.18.2. Sensory evaluation of balady bread.	33
3.2.2.19. Determination of bread staling.	33
3.2.2.20. Compressibility of balady bread	34
3.2.2.21. Statistical analysis.	34
4. RESULTS AND DISCUSSION	35
4.1. Quality attributes of pan bread made by frozen dough.	35
4.1.1. Physicochemical properties of tested wheat varieties.	35
4.1.2. Characteristics of tested wheat flours (72% ext.).	36
4.1.2.1. Proximate chemical composition.	36
4.1.2.2. Gluten characteristics.	37
4.1.2.3. Starch characteristics.	39
4.1.2.4. Color parameters.	40
4.1.2.5. Rheological properties.	41
4.1.2.5.1. Water hydration properties.	42
4.1.2.5.2. Farinograph parameters.	43
4.1.2.5.3. Extensograph parameters.	44
4.1.2.6. Enzymatic activity.	45
4.1.2.6.1. α -amylase activity.	45
4.1.2.6.2. Xylanase activity.	46
4.1.3. Characteristics of fresh and frozen doughs.	47
4.1.3.1. Dough yield.	47
4.1.3.2. Thermal properties during freezing.	48
4.1.3.3. pH values.	50
4.1.3.4. Enzymatic activity.	51
4.1.3.4.1. α -amylase activity.	51
4.1.3.4.2. Xylanase activity.	53
4.1.3.5. Fermentation activity.	56
4.1.3.5.1. Yeast survival counts.	56
4.1.3.5.2. Dough specific volume.	58
4.1.3.5.3. Gassing power.	61
4.1.4. Characteristics of pan bread made by frozen dough.	63
4.1.4.1. Dough weight loss during baking.	63
4.1.4.2. Pan bread yield.	64

IV

4.1.4.3. Pan bread volume.	65
4.1.4.4. Volume yield of pan bread.	67
4.1.4.5. Specific volume.	68
4.1.4.6. α -amylase activity.	70
4.1.4.7. Xylanase activity.	72
4.1.4.8. Sensory evaluation.	75
4.1.4.8.1. External characteristics.	75
4.1.4.8.2. Internal characteristics.	77
4.1.4.9. Crust color measurements.	81
4.1.4.10. Weight loss during storage.	82
4.1.4.11. Staling of pan bread.	84
4.2. Quality attributes of balady bread.	89
4.2.1. Proximate chemical composition of malt flour (MF).	89
4.2.2. Characteristics of wheat flours (WF, 82% ext.).	90
4.2.2.1. Physicochemical parameters.	90
4.2.2.2. Rheological properties.	93
4.2.2.2.1. Water hydration properties.	93
4.2.2.2.2. Farinograph parameters.	94
4.2.3. Effect of MF on the characteristics of dough and balady bread.	95
4.2.3.1. Yield and moisture content of dough.	95
4.2.3.2. Changes in the pH values during dough preparation.	96
4.2.3.3. Changes in the titratable acidity during dough preparation.	96
4.2.3.4. Determination of enzyme activity.	97
4.2.3.4.1. α -amylase activity.	97
4.2.3.4.2. Xylanase activity.	98
4.2.3.5. Baking characteristics of balady bread.	100
4.2.3.6. Sensory attributes of balady bread.	101
4.2.3.7. Moisture content of balady bread.	102
4.2.3.8. Staling rate of balady bread.	104
4.2.3.9. Compressibility of balady bread.	105
5. SUMMARY AND CONCLUSION	108
6. REFERENCES	119
7. ARABIC SUMMARY	

LIST OF TABLES

No.	Title	Page
1	Physicochemical properties of tested wheat varieties.	36
2	Proximate chemical composition of tested wheat flours (72% ext.).	37
3	Gluten characteristics of tested wheat flours (72% ext.).	38
4	Starch characteristics of tested wheat flours (72% ext.).	40
5	Color parameters of tested wheat flours (72% ext.).	41
6	Water hydration properties of tested wheat flours (72% ext.).	42
7	Farinograph parameters of tested wheat flours (72% ext.).	44
8	Extensograph parameters of tested wheat flours (72% ext.) at 90 min.	45
9	α -amylase activity for tested wheat flours (72% ext.).	46
10	Xylanase activity for tested wheat flours (72% ext.).	47
11	Yield of different freshly prepared doughs.	47
12	Thermal properties for different prepared doughs during freezing at $-18\pm 2^{\circ}\text{C}$.	48
13	Changes in pH values for different prepared doughs during 70 days of storage at $-18\pm 2^{\circ}\text{C}$.	50
14	α -amylase activity for different prepared doughs during 70 days of storage at $-18\pm 2^{\circ}\text{C}$.	52
15	Prediction equations of α -amylase activity for different prepared doughs during storage at $-18\pm 2^{\circ}\text{C}$.	53
16	Xylanase activity for different prepared doughs during 70 days of storage at $-18\pm 2^{\circ}\text{C}$.	54
17	Prediction equations of xylanase activity for different prepared doughs during storage at $-18\pm 2^{\circ}\text{C}$.	55