

CONTENTS

	Page No.
Titles	
Contents.....	I
Dedication.....	VI
Acknowledgements.....	VII
Abstract	VIII
Arabic abstract.....	IX
List of tables	X
List of figures	XI
List of plates.....	XII
List of appendices.....	XIII
CHAPTER ONE: INTRODUCTION.....	3
CHAPTER TWO: LITERATURE REVIEW.....	3
2.1 Cereal grains.....	3
2.1.1 Origin of cereals.....	3
2.1.2 Historical perspective of cereals.....	4
2.1.3 Cereal production, utilization and stocks.....	4
2.1.4 Importance of cereals.....	4
2.1.5 Applicability of cereals to make bread.....	5
2.2 Wheat grain.....	5
2.2.1 Production of wheat.....	6
2.2.2 Wheat classification.....	7
2.2.3 The Wheat berry.....	8
2.2.4 Composition of wheat grain.....	8
2.2.5 Grain attributes for specific market.....	9
2.3 Baked products.....	9
2.3.1 Traditional basis for classifying baked products.....	10
2.4 Bread.....	10
2.4.1 Definition of bread.....	11
2.4.2 Physical characteristics of bread.....	11
2.4.3 A Brief history of bread making.....	11

2.4.4 Bread types.....	12
2.4.5 The difference between bread and other baked products.....	13
2.4.6 Bread baking process.....	13
2.4.7 The basic bread recipe.....	14
2.4.7.1 Wheat flour.....	14
2.4.7.1.1 The flour milling process.....	15
2.4.7.1.2 Why we do mill wheat grain.....	16
2.4.7.1.3 Flour composition.....	16
2.4.7.1.3.1 Protein.....	16
2.4.7.1.3.2 Carbohydrates.....	17
2.4.7.1.3.3 Fiber.....	18
2.4.7.1.3.4 Fats.....	18
2.4.7.1.3.5 Mineral content/ ash.....	19
2.4.7.1.4 Different flours for different requirements	19
2.4.7.1.4.1 Bread flour.....	19
2.4.7.1.4.1.1 Grades of bread flours.....	22
2.4.7.1.4.1.1.1 Top grade.....	22
2.4.7.1.4.1.1.2 Baker's extra grade.....	22
2.4.7.1.4.1.1.3 Baker's grade.....	22
2.4.7.1.4.1.1.4 Euro baker's grade.....	22
2.4.7.2 Common salt (sodium chloride).....	23
2.4.7.3 Yeast (<i>Saccharomyces cerevisiae</i>).....	23
2.4.7.4 Water.....	25
2.4.7.5 Optional ingredients.....	26
2.4.7.5.1 Sugar.....	26
2.4.7.5.2 Ascorbic acid.....	26
2.4.7.5.3 Alpha-amylases.....	27
2.4.7.5.4 Emulsifiers.....	27
2.4.7.5.5 Hydrocolloids.....	28
2.4.8 Methods of bread production.....	28
2.4.9 The steps of baking process.....	28
2.4.9.1 Mixing.....	29
2.4.9.2 Fermentation (Proof).....	30

2.4.9.3 Dividing/scaling/depositing.....	31
2.4.9.4 Forming/moulding/shaping.....	31
2.4.9.5 Expansion and relaxation.....	32
2.4.9.6 Baking.....	32
2.4.9.7 Cooling.....	33
2.4.9.8 Packaging.....	34
2.4.9.9 Bread weights.....	34
2.4.9.10 Freshness of bread.....	35
2.4.9.11 Nutritional qualities of bread.....	35
2.4.9.12 Bread flavor.....	35
2.4.9.13 Color of bread.....	36
2.4.9.14 Deterioration of bread quality.....	36
2.4.9.14.1 Microbial growth.....	37
2.4.9.14.2 Nutritional losses.....	38
2.4.9.14.3 Moisture loss.....	38
2.4.9.14.4 Flavor loss.....	38
2.4.9.14.5 Staling.....	39
2.5 Food additives.....	40
2.5.1 European Community policy regarding additives.....	40
2.5.2 Why are additives used in foods?.....	40
2.5.3 Evaluation of safety of food additives.....	41
2.5.4 Bread improvers.....	42
2.5.5 Classification of improvers.....	42
2.6. Hydrocolloids.....	43
2.6.1 Types of hydrocolloids.....	44
2.6.2 Basic Structure of food hydrocolloid.....	44
2.6.3 Factors Influencing Behavior of food hydrocolloids.....	44
2.6.4 Use of hydrocolloids in food industries.....	45
2.6.5 Role of hydrocolloids in manufacture of baked goods.....	45
2.7 Emulsifiers.....	46
2.7.1 Emulsifiers as bread improver.....	47
2.7.2 Exudate gums.....	47
2.7.3 Gum arabic: gum acacia E414.....	48

2.7.3.1 Definition of gum arabic.....	49
2.7.3.2 Plant taxonomy of gum arabic.....	50
2.7.3.3 Hashab tree.....	50
2.7.3.4 Appearance of gum arabic.....	51
2.7.3.5 History and origin of gum arabic.....	51
2.7.3.6 Production of gum arabic.....	51
2.7.3.7 Collection of gum arabic.....	52
2.7.3.8 The difference between <i>A. senegal</i> and <i>A. seyal</i> gum.....	53
2.7.3.9 Grading of gum arabic.....	53
2.7.3.10 Gum arabic processing.....	54
2.7.3.11 Structure of gum arabic.....	54
2.7.3.12 Properties of gum arabic.....	56
2.7.3.13 Safety of gum arabic.....	58
2.7.3.14 Nutrition of gum arabic.....	59
2.7.3.15 Adverse effects and toxicity of gum arabic.....	60
2.7.3.16 Applications of gum arabic.....	60
2.7.3.17 Use of gum arabic in breadbaking.....	61
CHAPTER THREE: MATERIALS AND METHODS.....	63
3.1 Materials.....	63
3.1.1 Wheat flour.....	63
3.1.2 Gum arabic.....	63
3.1.3 Other raw material.....	63
3.2. Methods.....	63
3.2.1 Determination of moisture content.....	64
3.2.2 Determination of ash.....	64
3.2.3 Determination of crude protein.....	65
3.2.4 Determination of fat content.....	65
3.3 Breadmaking processes.....	66
3.3.1 The bread recipes.....	66
3.3.2 Weighing of raw material.....	66
3.3.3 Mixing.....	66
3.3.4 First fermentation (proofing).....	67
3.3.5 Dividing.....	67

3.3.6 Second Fermentation.....	67
3.3.7 Baking process.....	67
3.3.8 Cooling process.....	67
3.3.9 Measuring of specific volume.....	67
3.3.10 Color measurement.....	68
3.3.11 Slicing process.....	68
3.3.12 Sensory evaluation.....	68
3.3.13 Statistical analysis.....	68
CHAPTER FOUR: RESULTS AND DISCUSSION..	70
4.1 Proximate composition of wheat flour and gum arabic.....	70
4.2 Effect of gum arabic on fermentation time.....	70
4.3 Effect of gum arabic on baking time.....	70
4.4 Effect of gum arabic on specific volume of A ₁ and A ₂ bread	74
4.5 Effect of gum arabic addition on specific volume of B bread.....	74
4.6 Effect of gum arabic on bread colors (a/b) of crumb and crust of A ₁ and A ₂ bread..	79
4.7 Effect of Gum arabic addition on Sensory evaluation.....	79
CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS.	86
5.1 Conclusions.....	86
5.2 Recommendations.....	86
References	87
Appendices	93

DEDICATION

To my family for their support, help, advice, understanding and accepting me in the way I am.

To my advisor professor: Ahmad Etawad Elfaki for his advising, my friends for their helping, and for you my dear reader.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Professor Ahmad Elawad Elfaki for his advice, guidance and supervision throughout my research career. I would also like to thank my parents, my wife and my friends for their assistance throughout the period of my study.

Abstract

This study was carried out to investigate the effect of gum arabic as natural additive on bread quality. Gum arabic was added as 0.5, 1.0, 1.5 and 2.0% (w/w flour) compared to 0.0% as control. Wheat flour (extraction 72%) was obtained from A Flour Mills, Khartoum North, Sudan, and has been used as two types of flour [without additives (A_1) and with additives (A_2) (ascorbic acid and α -amylase at 80 ppm)]. Another type of flour was obtained from B Flour Mills, Khartoum North, Sudan, (commercial bread flour) for comparison. Bread was made from the different flours. Proximate analysis, physico-chemical properties, and organoleptic characteristics were conducted at fresh bread and after 8 hours of storage. Gum arabic had no significant effect on fermentation time, baking time and color measurements at α -level (0.05). Addition of gum arabic decreased specific volume by 6.4%, 19.2% and 20.1% for A_1 flour, and A_2 flour, and B flour, respectively. Generally, sensory panelists preferred the addition of 0.5% gum arabic in fresh bread and 1.0% gum arabic in bread made from A_1 flour and stored for 8 hours and similarity B flour. In A_2 flour, 0.5% gum arabic was preferred in both, fresh and stored bread. Although addition of gum arabic decreased the bread specific volume, but it can be used in flat bread for kidney patients.

المخلص

هذه الدراسة أجريت لإختبار أثر إضافة الصمغ العربي كمضاف طبيعي على جودة الخبز، أضيف الصمغ العربي بنسب 0.5، 1.0، 1.5 و 2.0 % من وزن الطحين مقارنة بالعينة غير المعاملة (0.0%)، طحين القمح (72% نسبة الإستخلاص) تم الحصول عليه من مطاحن أ، الخرطوم بحرى، السودان، إستخدم على معاملتين هما: خالي من المحسنات (أ₁) ومضاف له محسنات (أ₂) (حمض الأسكوربيك وإنزيم ألفا أميليز بنسب 80 جزء من المليون)، وطحين آخر من مطاحن ب للغلال، الخرطوم بحرى، السودان، (طحين الخبز التجارى) للمقارنة. الخبز تم صنعه من مختلف الطحين. التحليل التقريبي والخصائص الفيزيائية، والخواص الحسية تم إجرائها في حالة الخبز الطازج وبعد 8 ساعات من التخزين. إضافة الصمغ العربي لم تعط نتائج ذات تأثير معنوي في زمن التخمر والخبز وقراءة اللون عند مستوى معنوية (0.05)، إضافة الصمغ العربي قلصت الحجم النوعي للخبز بمتوسط 6.4%، 19.21% و 20.11% للطحين أ₁ والطحين أ₂ والطحين ب على التوالي. عموماً، المحكمون الحسيون فضلوا الإضافة 0.5% صمغ عربي في حالة الخبز الطازج و 1.0% صمغ عربي في الخبز المصنوع من الطحين أ₁ للخبز المخزن، وكذلك للطحين ب، في الطحين أ₂ كانت 0.5% صمغ عربي هي الأفضل في كليهما، الخبز الطازج والمخزن. بالرغم من أن إضافة الصمغ العربي قلصت الحجم النوعي للخبز، لكنّه يمكن أن يُستعملَ في الخبز المستوي لمرضى الكلى.

LIST OF TABLES

Table No.	Page No.
Table 1: Wheat classification	7
Table 2: Composition of wheat	9
Table 3: Classification of baked products	10
Table 4: The basic bread recipe for a one kilogram (about two pounds) loaf of bread	14
Table 5: General composition of wholemeal and white flour	16
Table 6: Flour types used in the manufacture of baked products	21
Table 7: Composition of bread (per 100g)	35
Table 8: Guideline quantities of substances used to improve the baking of products made using milled wheat or rye expressed as a percent, of the dough weight	43
Table 9: Some information about gum arabic	49
Table 10: Gum arabic production in Sudan (5-year annual averages) between 1960 and 1994	52
Table 11: Commercial grades of <i>Acacia senegal</i> gum from Sudan	53
Table 12: Analytical data for the gum obtained from <i>Acacia senegal</i>	55
Table 13: Basic recipe	66
Table 14: Mechanism of Colorimeter (Colorflex EZ) instrument	68
Table 15: Proximate composition (%) of mixture of flour and gum arabic	71
Table 16: Effect of gum arabic on fermentation time (min.) of A flours	72
Table 17: Effect of gum arabic on baking time (min.) of A flours	73
Table 18: Specific volume of A bread samples	76
Table 19: Decreasing of specific volume of A bread samples (%)	76
Table 20: Specific volume of B bread	77
Table 21: Decreasing of specific volume of B bread (%)	77
Table 22: Summary of decreasing of specific volume (%) on bread samples	77
Table 23: Effect of gum arabic on color (a/b) in A bread samples	80
Table 24: Grouping sensory attributes of A ₁ bread using Fisher method	81
Table 25: Grouping sensory attributes of A ₂ bread using Fisher method	82
Table 26: Grouping sensory attributes of B bread using Fisher method	84
Table 27: General comparison between fresh bread and bread after 8 hours	85

LIST OF FIGURES

Figure No.	Page No.
Figure 1: Wheat production in 2015 forecast to contract slightly below the record of 2014	6
Figure 2: The makeup of bread flour	20
Figure 3: Typical structural features of gum arabic	56
Figure 4: Viscosity curve of an aqueous gum arabic solution	57
Figure 5: Models of gum arabic as an emulsifier in oil-in-water emulsions	58
Figure 6: Comparison of overall acceptability of A ₁ fresh bread and after 8 hours of storage	81
Figure 7: Comparison of overall acceptability of A ₂ fresh bread and after 8 hours of storage	82
Figure 8: Comparison of overall acceptability of B fresh bread and after 8 hours of storage	84

LIST OF PLATES

Plate No.	Page No.
Plate 1: A ₁ bread	75
Plate 2: A ₂ bread	75
Plate 3: B bread	75

LIST OF APPENDICES

Appendix No.	page No.
Appendix 1: Crosstabulation of color	93
Appendix 2: Crosstabulation of flavor	94
Appendix 3: Crosstabulation of taste	95
Appendix 4: Crosstabulation of texture	96
Appendix 5: Crosstabulation of general acceptable	97
Appendix 6: Questionnaire of panel test of bread samples	98
Appendix 7: Color reading of crumb and crust of A bread samples	99
Appendix 8: Effect of gum arabic on specific volume of different bread types	100
Appendix 9: ANOVA table (Analysis Of Variance)	101
Appendix 10: General comparison between total of fresh bread and Bread after 8 hours	102
Appendix 11: Relation between gum arabic addition and specific volume of B bread	103
Appendix 12: Relation of gum arabic treatment and specific volume in all bread samples	104