

**EFFECT OF SOME AROMATIC PLANTS AND
THEIR ESSENTIAL OILS ON PAN BREAD
QUALITY**

By

HANAA AHMED RAGAEI MOHAMED

B.Sc. Agric. Sci. (General Division), Fac. Agric., Banha Univ., 2002

M.Sc. Agric. Sci. (Food Science), Fac. Agric., Cairo Univ., 2013

THESIS

**Submitted in Partial Fulfillment of the
Requirements for the Degree of**

DOCTOR OF PHILOSOPHY

In

**Agricultural Sciences
(Food Science)**

**Department of Food Science
Faculty of Agriculture
Cairo University
EGYPT**

2019

Format Reviewer

Vice Dean of Graduate Studies

Name of Candidate: Hanaa Ahmed Ragaei **Degree:** Ph. D.
Title of Thesis: Effect of Some Aromatic Plants and Their Essential Oils
on Pan Bread Quality
Supervisors: Dr. Yahia Ibrahim Sallam
Dr. Ahmed Salama El-Leithy
Dr. Safaa Ezzat Ali
Department: Food Science **Branch:** Food Science
Date: 29 /9/ 2019

ABSTRACT

Ajwain (*Trachyspermum ammi* L.) seeds and thyme (*Thymus vulgaris*) powders and their essential oils as natural food preservative agents were studied. Ajwain seeds and thyme leaves yielded of 2.8 and 1.1% (on dry weight basis) essential oils. Thymol (35.80 - 38.07 %), ρ -cymene (34.76 - 26.33%) and γ -terpinene (19.20 - 8.11%) were identified as major constituents of ajwain and thyme essential oil, respectively. The total phenolic contents of aqueous extracts of ajwain and thyme were 8.77 and 25.28 mg GAE/g dry mater, respectively. Meanwhile, total flavonoid contents were 6.55 and 80.00 QE/g dry mater, respectively. The essential oils of ajwain and thyme revealed antioxidant activity where, IC_{50} was 30.44 and 28.31 μ g/ml. Ajwain essential oil was more effective against *A. niger* than thyme essential oil. Meanwhile, *S. cerevisiae* was more sensitive against thyme than ajwain. Rheological studies showed that an increase in replacement level led to an increase in water absorption of wheat flour 72% extract and a decrease in dough stability. Ajwain and thyme powders were used to replace 2, 4 and 6% of pan bread wheat flour and their essential oils were incorporated at 200 μ l/4g sunflower oil. all samples were acceptable by panelists. except, at level of 6%. Specific volume of pan bread samples was decreased with increasing substitutes level. Sample containing 4% thyme (T₄) recorded the lowest specific volume. Crumb color was significantly affected ($p < .05$), since increasing replacement level gradually increased darkness, and decreased yellowness. The a^* values for ajwain increased while, a^* values of thyme decreased. Textural profile analysis showed an increase in hardness and reduce in resilience. Concerning cohesiveness, T₄ sample recorded the lowest score. with no significant differences comparing to control sample. Ajwain and thyme powders exhibited good antimicrobial activity and prolonged pan bread shelf life for seven days as sodium propionate did. Meanwhile, shelf life of bread incorporated with essential oils of ajwain and thyme were only five days.

Key words: Ajwain; Thyme; Pan bread quality; Consumer acceptance; Shelf life

LIST OF TABLES

No.	Title	Page
1.	Pan bread ingredients.....	35
2.	Chemical composition of raw materials (on dry weight basis)	41
3.	Physicochemical properties of sunflower oil	43
4.	Identification of sunflower fatty acids.....	44
5.	Physicochemical properties of ajwain seeds and thyme leaves essential oil.....	47
6.	Chemical components of ajwain seeds essential oil.....	49
7.	Chemical components of thyme leaves essential oil.....	51
8.	Total phenolic and total flavonoids contents of ajwain seeds and thyme leaves extracts.....	53
9.	The antioxidant activity of ajwain seeds and thyme leaves essential oils.....	56
10.	Minimum inhibitory concentration (MIC) of the ajwain seeds and thyme leaves essential oil.....	57
11.	Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders on rheological characteristics of wheat flour	59
12.	Effect of ajwain seed and thyme leaves powders and their essential oils on baker's yeast activity (dough expansion)	62
13.	Consumer acceptability of pan bread samples contained powders of ajwain seeds and thyme leaves and their essential oils.....	64
14.	Sensory evaluation of pan bread samples	67

LIST OF TABLES (Continued)

No.	Title	Page
15.	Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on specific volume of pan bread.....	69
16.	Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on pan bread crumb color.....	72
17.	Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on pan bread crust color.....	74
18.	Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on pan bread textural characteristics.....	76
19.	Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on pan bread shelf life.....	80

LIST OF FIGURES

No.	Title	Page
1.	Gas chromatography of fatty acids methyl esters from sunflower oil.....	45
2.	Chromatogram of ajwain seed essential oil.....	49
3.	Chromatogram of thyme leaves essential oil.....	52
4.	Farinogram parameters wheat flour 72% extraction substituted with powders of ajwain seeds and thyme leaves.....	60
5.	Dough expansion of different treatments.....	63
6.	The consumer acceptability of different pan bread samples	65
7.	Pan bread with the addition of different levels of ajwain seeds and thyme powders or their essential oils.....	68
8.	Specific volume of pan bread samples	71

CONTENTS

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	5
1. Proximate analysis of raw materials.....	5
2. Recovery and yield of essential oils.....	7
3. Physicochemical properties of essential oils.....	8
4. Chemical composition of essential oils.....	10
5. Antioxidant activity of ajwain and thyme.....	13
6. Antimicrobial activity of ajwain and thyme.....	14
7. Bakery products and pan bread.....	17
8. Effect of replacement on rheological properties of wheat flour.....	18
9. Effect of partially wheat flour replacement on physical properties of bakery products.....	21
10. Effect of partially wheat flour replacement on sensory characteristics of bakery products.....	23
11. Effect of replacement on microbial growth.....	24
MATERIALS AND METHODS	27
RESULTS AND DISCUSSION	41
1. Proximate analysis of raw materials.....	41
2. Physicochemical properties of sunflower oil.....	42
3. Identification of sunflower fatty acids.....	43
4. Recovery and yield of ajwain seeds and thyme leaves essential oils.....	46
5. Physicochemical properties of ajwain seeds and thyme leaves essential oils.....	47
6. Chemical composition of ajwain seeds and thyme leaves essential oils.....	48

CONTENTS (Continued)

	Page
7. Determination of total phenolic (TPC) and total flavonoid (TFC) contents of ajwain seeds and thyme leaves extracts.....	52
8. Determination of antioxidant activity of ajwain seeds and thyme leaves essential oils.....	55
9. Determination of microbial activity of ajwain seeds and thyme leaves essential oils.....	57
10. Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders on rheological characteristics of wheat flour.....	58
11. Effect of ajwain seeds and thyme leaves powders and their essential oils on yeast activity (dough expansion).....	62
12. Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on consumer acceptability of pan bread.....	64
13. Sensory evaluation of pan bread.....	65
14. Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on specific volume of pan bread.....	69
15. Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on pan bread color.....	71
a. Pan bread crumb color.....	71
b. Pan bread crust color.....	74
16. Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on pan bread textural characteristics.....	75
17. Effect of replacement of wheat flour 72% extraction by ajwain seeds and thyme leaves powders or their essential oils on microbial growth of pan bread.....	79

CONTENTS (Continued)

	Page
CONCLUSION	83
SUMMARY	85
REFERENCES	93
ARABIC SUMMARY	