

# **STUDIES ON MUDAFFARA CHEESE AS AFFECTED BY SOME SPICES**

**By**

**AHMED MOHAMED BAKHEIT**

**B.Sc., Agric. Sci. (Dairy Science), Fac. Agric., Alex. Univ., Egypt, 1984  
M.Sc. Agric. Sci. (Animal production), Fac. Agric., Gazira Univ.,  
Sudan, 2000**

**THESIS**

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

**DOCTOR OF PHILOSOPHY**

**In**

**Agricultural Sciences  
(Dairy Science)**

**Department of Dairy Science  
Faculty of Agriculture  
Cairo University  
EGYPT  
2010**

**APPROVAL SHEET**

**STUDIES ON MUDAFFARA CHEESE AS  
AFFECTED BY SOME SPICES**

**Ph.D. Thesis  
In  
Agric. Sci. (Dairy Science)**

**By**

**AHMED MOHAMED BAKHEIT**

**B.Sc., Agric. Sci. (Dairy Science), Fac. Agric., Alex. Univ., Egypt, 1984  
M.Sc. Agric. Sci. (Animal production), Fac. Agric., Gazira Univ.,  
Sudan, 2000**

**APPROVAL COMMITTEE**

**Dr. MAHMOUD ABD EL-HALEIM DEGHEIDI.....**  
**Professor of Dairy Science, Fac. Agric., EL-Fayoum University**

**Dr. MONIR MAHMOUD IBRAHEIM EL-ABD.....**  
**Professor of Dairy Science, Fac. Agric., Cairo University**

**Dr. MOHAMED NAGEIB ALI HASSAN.....**  
**Professor of Dairy Science, Fac. Agric., Cairo University**

**Dr. ABOU EL-SAMH MOHAMED MEHRIZ .....**  
**Professor of Dairy Science, Fac. Agric., Cairo University**

**Date:     /     /2010**

**SUPERVISION SHEET**

**STUDIES ON MUDAFFARA CHEESE AS  
AFFECTED BY SOME SPICES**

**Ph.D. Thesis  
In  
Agric. Sci. (Dairy Science)**

**By**

**AHMED MOHAMED BAKHEIT**

**B.Sc., Agric. Sci. (Dairy Science), Fac. Agric., Alex. Univ. Egypt, 1984  
M.Sc. Agric. Sci. (Animal production), Fac. Agric., Gazira Univ.,  
Sudan, 2000**

**SUPERVISION COMMITTEE**

**Dr. ABOU EL-SAMH MOHAMED MEHRIZ**  
**Professor of Dairy Sci., Fac. Agric., Cairo University**

**Dr. MOHAMED NAGEIB ALI HASSAN**  
**Professor of Dairy Sci., Fac. Agric., Cairo University**

**Dr. MERVAT IBRAHIM FODA**  
**Researcher Professor of Dairy Sci., NRC, Giza**

# دراسات على الجبن المضفر وتأثير بعض التوابل عليها

رساله مقدمة من

**أحمد محمد بخيت**

بكالوريوس في العلوم الزراعيه (علوم الالبان)- كلية الزراعة – جامعة الإسكندرية ١٩٨٤  
ماجستير في العلوم الزراعيه (قسم الإنتاج الحيوانى)- كلية الزراعة – جامعة الجزيرة- السودان ٢٠٠٠

للحصول على درجة

دكتوراة الفلسفة

في

العلوم الزراعيه  
(علوم الالبان)

قسم علوم الالبان  
كلية الزراعة  
جامعة القاهرة  
مصر

٢٠١٠

## دراسات على الجبن المضفر وتأثير بعض التوابل عليها

رساله مقدمة من

**أحمد محمد بخيت**

بكالوريوس في العلوم الزراعيه (علوم الالبان)- كلية الزراعة – جامعة الإسكندرية ١٩٨٤  
ماجستير في العلوم الزراعيه (قسم الإنتاج الحيوانى)- كلية الزراعة – جامعة الجزيرة- السودان ٢٠٠٠

### لجنة الحكم

دكتور / محمود عبد الحليم دغيدى  
أستاذ الألبان - كلية الزراعة – جامعة الفيوم

دكتور / منير محمود إبراهيم العبد  
أستاذ الألبان – كلية الزراعة – جامعة القاهرة

دكتور / محمد نجيب على حسن  
أستاذ الألبان - كلية الزراعة – جامعة القاهرة

دكتور / أبو السمح محمد محرز  
أستاذ الألبان - كلية الزراعة – جامعة القاهرة

التاريخ: ٢٠١٠ / ٠٩ / ١٥

# دراسات على الجبن المضفر وتأثير بعض التوابل عليها

رساله مقدمة من

**أحمد محمد بخيت**

بكالوريوس في العلوم الزراعيه (علوم الالبان)- كلية الزراعة - جامعة الإسكندرية ١٩٨٤  
ماجستير في العلوم الزراعيه (قسم الإنتاج الحيوانى)- كلية الزراعة - جامعة الجزيرة- السودان ٢٠٠٠

لجنة الإشراف

دكتور/ أبو السمح محمد محرز  
أستاذ الألبان - كلية الزراعة - جامعة القاهرة

دكتور/ محمد نجيب على حسن  
أستاذ الألبان - كلية الزراعة - جامعة القاهرة

دكتور/ ميرفت إبراهيم فوده  
أستاذ باحث الألبان - المركز القومي للبحوث

## DEDICATION

*I gratefully dedicate this work to soul of my mother as well as to my father and to whom my heart felt thanks; to my wife Samia and my sons for their patience and support they lovely offered along the period of my post graduation.*

## *ACKNOWLEDGEMENT*

*First of all I thank the Omniscient Allah. Secondly I wish to express my sincere thanks, deepest gratitude and appreciation to Dr. Abou El-Samh Mohamed Mehriz and Dr. Mohamed Nageib Ali Hassan, professors of Dairy Science and Technology, Faculty of Agriculture, Cairo University, for their help, encouragement and guidance which they have provided throughout the period of study.*

*Sincere thanks to Dr. Mervat Ibrahim Foda, Researcher professor of Dairy Technology, NRC, Giza, for her continuous supervision and the true help offered throughout the lab work.*

*Grateful appreciation is also extended to all staff members of Dairy Science and Technology Department, Faculty of Agriculture, Cairo University.*

*Special deep appreciation is given to my brothers and sisters. Also I feel deeply grateful to my dear country Sudan and highly offer my respect and gratitude to the Egyptian Government who made this work possible through the scholarship offered to me.*



<b>Name of Candidate:</b> Ahmed Mohamed Bakheit	<b>Degree:</b> Ph. D.
<b>Title of Thesis:</b> Studies on Mudaffara Cheese as Affected by Some Spices.	
<b>Supervisors:</b> Dr. Abou El-Samh Mohamed Mehriz Dr. Mohamed Nageib Ali Hassan Dr. Mervat Ibrahim Foda	
<b>Department:</b> Dairy Science	<b>Approval:</b> 15/ 09 /2010

### ABSTRACT

Mudaffara cheese is a semi-hard type cheese widely known in some Middle East countries. Little information is available concerning its properties. The effect of some spices on its chemical, microbiological, organoleptical and rheological (meltability) properties as well as its antioxidant activity and different flavor components were studied during ambient and cold storage. Spices used were clove, black cumin and black pepper.

The obtained results indicated that the chemical components of different spices-containing Mudaffara cheeses were markedly affected during ambient than cold storage. Regarding the microbiological properties, it was found that spices-containing cheeses had lower coliform, mold and yeast and total bacterial count than that of the spices-free cheese. Concerning the meltability, it was greatly affected by storage period and storage temperature regardless the type of spices used.

The organoleptic properties of cold stored was improved upon incorporation of spices in cheese making. Opposite to that was the situation with the ambient stored where spices-free Mudaffara cheese (control) scored higher marks.

The antioxidant activity of spices-containing cheese was higher when clove was added, followed by that of black cumin and black pepper cheeses respectively. The volatile components in experimented Mudaffara cheese were aldehydes, ketones, fatty acids, esters, alcohols, hydrocarbons and miscellaneous compounds. All these components were detected in higher percentages at room temperature than refrigerated storage.

It can be concluded that spices incorporation improved the different Mudaffara cheese properties beside their therapeutic functions.

**Key words:** Mudaffara cheese, Spices, Chemical and microbiological properties, Clove, Black cumin, Black pepper, Volatile compounds and flavors, Antioxidant activity.

# CONTENTS

	Page
<b>INTRODUCTION</b> .....	1
<b>REVIEW OF LITERATURE</b> .....	5
<b>1. Herbs and Spices</b> .....	6
a. Dietary benefits of herbs and spices .....	7
1. Flavor enhancement.....	7
2. The preservation properties of spices.....	7
3. Antibacterial activity of spices .....	9
4. Antifungal activity of spices.....	12
5. Effect of spices on mycotoxins production.....	14
6. Antioxidant activity of spices .....	15
b. Health benefits of herbs and spices.....	20
c. The most common spices and their properties.....	22
1. Clove.....	23
2. Black cumin.....	27
3. Black pepper.....	28
d. Spices in cheese technology .....	29
<b>2. Pasta-Filata cheese</b> .....	32
a. Chemistry of stretching in Pasta-Filata cheese.....	33
b. Meltability of Pasta-Filata cheese.....	33
c. Factors affect functional properties of Pasta-Filata cheese...	34
d. Microbial quality of Pasta-Filata cheese.....	38
e. Proteolysis of Pasta-Filata cheese.....	39
f. Protein and lipid oxidation during Pasta-Filata cheese manufacturing.....	40
g. Prolonging keeping quality and shelf-life of Pasta-Filata cheese.....	41
h. Flavor compounds in Pasta-Filata and some other cheeses	43
<b>MATERIALS AND METHODS</b> .....	50
<b>1. MATERIALS</b> .....	50
<b>2. METHODS</b> .....	53
a. Experimental procedure.....	53
b. Analytical methods.....	55
c. Volatile compounds of experimental cheese and spices.....	57
d. Sensory evaluation.....	59
e. Statistical analysis.....	59
<b>RESULTS AND DISCUSSION</b> .....	60

1. Effect of some spices on some chemical composition of Mudaffara cheese.....	60
2. Effect of some spices on some rheological properties (meltability) of Mudaffara cheese.....	80
3. Effect of spices added on the microbiological properties of Mudaffara cheese.....	84
4. Volatile compounds of experimental Mudaffara cheese.....	94
5. Antioxidant activity of experimental Mudaffara cheese .....	153
6. Organoleptic evaluation of experimental Mudaffara cheese.....	165
SUMMARY .....	181
REFERENCES.....	184
ARABIC SUMMARY	

## LIST OF TABLES

No.	Title	Page
1.	Bioactive chemical compounds isolated from some of the most common used spices .....	18
2.	A Partial list of the most common spices.....	23
3.	Effect of some spices on the moisture (%) of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	61
4.	Effect of some spices on the fat (%) of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	64
5.	Effect of some spices on the protein (%) of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	67
6.	Effect of some spices on the water soluble nitrogen (%) of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	71
7.	Effect of some spices on the acidity (%) of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	74
8.	Effect of some spices on the pH of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C.....	78
9.	Effect of some spices on the meltability of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	81
10.	Total bacterial count as affected by some spices added to Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	85
11.	Molds and Yeasts count as affected by some spices added to Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	88

12. Coliform count as affected by some spices added to Mudaffara cheese during storage for 8 weeks at $7\pm 2$ and $30\pm 2^{\circ}\text{C}$ .....	92
13. Relative abundance of aldehydes, ketones and fatty acids identified in control Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	97
14. Relative abundance of hydrocarbons and esters identified in control Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	98
15. Relative abundance of alcohols and miscellaneous compounds identified in control Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	99
16. Relative abundance of aldehydes and ketones identified in clove powder and clove Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	110
17. Relative abundance of hydrocarbons and fatty acids identified in clove powder and clove Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	111
18. Relative abundance of alcohols identified in clove powder and clove Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	112
19. Relative abundance of esters and miscellaneous compounds identified in clove powder and clove Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	113
20. Relative abundance of aldehydes, ketones and fatty acids identified in black cumin powder and black cumin Mudaffara cheese during storage for 8 weeks at $30\pm 2$ and $7\pm 2^{\circ}\text{C}$ .....	124
21. Relative abundance of esters identified in black cumin powder and black cumin Mudaffara cheese during	

storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	125
22. Relative abundance of hydrocarbons and alcohols identified in black cumin powder and black cumin Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	126
23. Relative abundance of miscellaneous compounds identified in black cumin powder and black cumin Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	126
24. Relative abundance of aldehydes and ketones identified in black pepper powder and black pepper Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	134
25. Relative abundance of esters and fatty acids identified in black pepper powder and black pepper Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	135
26. Relative abundance of alcohols identified in black pepper powder and black pepper Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	136
27. Relative abundance of hydrocarbons identified in black pepper powder and black pepper Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	137
28. Relative abundance of miscellaneous compounds identified in black pepper powder and black pepper Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	138
29. Total relative flavor compounds detected in all spices containing Mudaffara cheese during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C.....	150
30. Antioxidant activity (%) of spices free (control) Mudaffara cheese determined by DPPH during storage for 8 weeks at 30 $\pm$ 2 and 7 $\pm$ 2°C compared to the synthetic compound (TBHQ) .....	157

31. Antioxidant activity (%) of clove powder and clove Mudaffara cheese determined by DPPH during storage for 8 weeks at 30±2 and 7±2°C compared to the synthetic compound (TBHQ) .....	159
32. Antioxidant activity (%) of black cumin powder and black cumin Mudaffara cheese determined by DPPH during storage for 8 weeks at 30±2 and 7±2°C compared to the synthetic compound (TBHQ).....	161
33. Antioxidant activity (%) of black pepper powder and black pepper Mudaffara cheese determined by DPPH during storage for 8 weeks at 30±2 and 7±2°C compared to the synthetic compound (TBHQ).....	164
34. Effect of some spices on the taste of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C.....	166
35. Effect of some spices on the odor of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C.....	169
36. Effect of some spices on the color of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C.....	171
37. Effect of some spices on the body and texture of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C .....	173
38. Effect of some spices on the acceptability of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C.....	175
39. Effect of some spices on overall parameters (total scores) of Mudaffara cheese during storage for 8 weeks at 7±2 and 30±2°C.....	178