

STUDIES ON SOME FACTORS AFFECTING
BUTTER FLAVOUR

By

Saad El-Din Mohamed Miligy Farahat
(B.Sc., M.Sc.)

Thesis

Submitted in Partial Fulfilment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

To the

Food Science Department
Faculty of Agriculture
Ain-Shams University

1971

APPROVAL SHEET

Name : Saad El-Din Mohamed Miligy Farahat
Title : Studies on Some Factors Affecting Butter Flavour

Thesis has been

Approved by :

A. A. Tawfik

Ahmed F. Hassan

E. A. H. H.

Committee in Charge

Date : 22 / 4 / 1971

...00000...



A C K N O W L E D G M E N T

The writer is greatly indebted to Prof. A.A. Hofi, Professor of Food and Dairy Chemistry, Food Science Department, for suggesting the problem, kind encouragement, valuable guidance, constructive criticism during the course of this study and preparation of the thesis.

I am also truly thankful to Prof. M. Fahmy, Professor of Microbiology and Dean of the Faculty of Agriculture , Zagazig for his keen interest and well appreciated assistance.

Sincere gratitude and appreciation should be also expressed to Dr. G. Mahran, Food Science Department for his helpful advice and valuable suggestions throughout this investigation.

Thanks are also due to all staff members of Food Science Department, Faculty of Agriculture, Shubra-El-Kheina for the facilities they had kindly offered.

...ooOoo...

C O N T E N T S

	Page
INTRODUCTION	1
REVIEW OF LITERATURE :	
Factors Affecting Major Butter Flavour Components	4
I- Effect of Microbial Contamination :	
a- Air-borne and ventilation	7
b- Microorganisms shedded by human	10
c- Microorganisms shedded by equipment ...	12
d- Microorganisms shedded by packaging materials	13
II- Effect of Cream Pasteurisation	14
III- Effect of Cream Ripening	15
IV- Effect of Salt Addition	17
V- Effect of Storage Temperature	18
MATERIALS AND METHODS :	
Materials	21
Butter Processing	21
Sampling	21
Methods :	
I- Microbial Examination :	
1- Microbial examination of cream and butter	22
a- Total bacterial count (TBC)	22
b- Total mould and yeast count (TMYC) ..	22
2- Total counts of air-borne microorganisms	23
3- Total counts of butter equipment and paper packages microorganisms	24
4- Total counts of microorganisms shedded by labour hands	24
II- Butter Scoring	25

	Page
III- Chemical Analysis	25
1- Titratable acidity	25
2- pH determination	25
3- Moisture content	26
4- Fat content	26
5- Salt content	26
6- Total volatile fatty acids (T.V.F.A.)..	27
7- Chromatographic determination of C5 & higher, butyric, propionic, and acetic acids contents in butter	28
8- Isolation and determination of neutral compounds (Diacetyl and acetoin comp- ounds)	30
I- Diacetyl determination	30
II- Acetoin determination	33
 PART I :	
Section 1 :	
Flavour Chemical Characters of Market Butter	34
Experimental	34
Results and Discussion	35
Section 2 :	
Effect of Some Environmental Conditions on the Degree of Contamination by Air-borne Microorganisms	39
Experimental	39
Results and Discussion	41
Summary and Conclusion	46
PART II :	48
Section 1 :	
Cream Pretreatment	49
Experimental	49
Results and Discussion	51
Section 2 :	
Degree of Air-borne Contamination	60
Experimental	60
Results and Discussion	62

	Page
Section 3 :	
Cleaning and Sterilizing of Butter Equipment	73
Experimental	73
Results and Discussion	75
Section 4 :	
Cleanliness of Labour Hands	83
Experimental	83
Results and Discussion	85
Section 5 :	
Salt Addition	92
Experimental	92
Results and Discussion	93
Section 6 :	
Packaging Materials	100
Experimental	100
Results and Discussion	102
Section 7 :	
Storage Temperature	109
Experimental	109
Results and Discussion	110
SUMMARY AND CONCLUSION	115
REFERENCES	120
ARABIC SUMMARY.	

...ooOoo...

INTRODUCTION

During this century, attention of Food Scientist has been drawn to food quality within the following pattern;

1. from about 1930 and on, they were concerned with food nutritional value,
2. round about 1950, they were more attracted to food quality as indicated by consumer's preference measures, and
3. lately and starting from about 1960, they began to step forward to factors responsible for flavour components deterioration with special reference to environmental contamination, in other words, how to keep flavour characteristics during shelf-life.

Under the recent dairy industries schemes in the U.A.R.; table butter production and consumption have begun to increase. During marketting, butter was found to undergo some unfavourable problems due to some inefficient procedures during production. Those problems are in the main, flavour ones.

Flavour property is normally awarded highest score points among other food quality attributes; for that reason regulations for butter substitutes manufacture specify the inclusion of flavouring materials, e.g. diacetyl etc;

or some dairy by-products which could act as flavour components precursors in the used formula.

Diacetyl and acetoin have long been considered the important criterion for the desirable flavour in dairy products, fatty ones in particular. Contrary to that, the presence of free fatty acids (F.F.A.) in relatively high levels has long been recognized as an important contributor to off-flavour. Recent investigations have been concerned not only with maximizing diacetyl and acetoin contents and with minimizing the F.F.A. contents in butters, but also with how to maintain the former desirable flavour components as long as they can without any deterioration. Such deterioration would definitely concern all bodies engaged, actually; manufacturer; wholesaler; retailers ; and consumers.

Providing butter with ample levels of those derived components would be thus quite an achievement. That could not be attained without studying the factors responsible for any loss or decline in such levels. With that in view, this work was planned to investigate butter flavour and its respective components as affected by some processing conditions. This work was covered in two main parts.

The first part was conducted in the two following sections (1 & 2) to throw some light on ;

1. Flavour chemical characters of market butter.
2. Effect of some environmental conditions on the degree of air-borne contamination in college butter manufacture room.

The second part was devoted to study butter flavour deterioration as affected by some environmental conditions as successively given ;

1. Cream pretreatments
2. Degree of air-borne contamination.
3. Cleaning and sterilizing butter equipment
4. Cleanliness of labour hands.
5. Salt addition.
6. Packaging materials.
7. Storage temperature.

Besides the academic importance of this investigation, any information attained would be quite of some value economically and commercially for this growing dairy industry.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

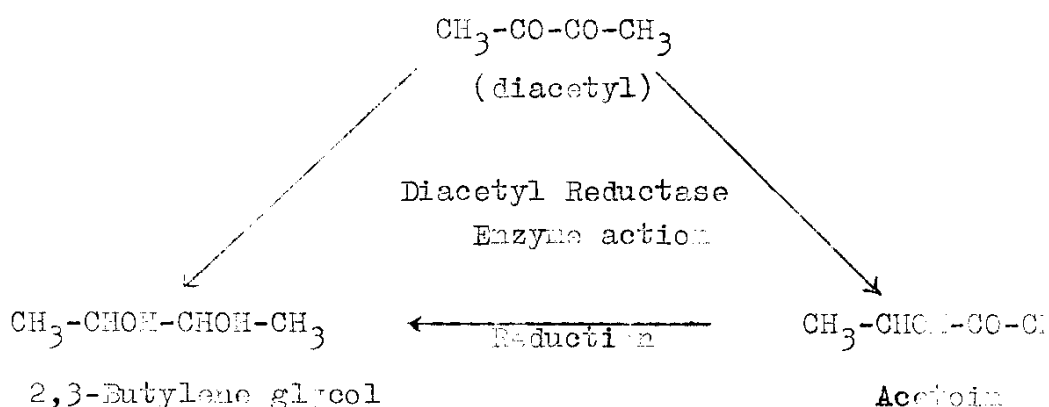
Factors Affecting Major Butter Flavour Components :

I- Effect of Microbial Contamination :

Van Niel et al. (1929) found that the content of diacetyl in butter being about 2-4 ppm, were responsible for aromatic flavour in butter. Many investigations have been carried out concerning the existence of diacetyl in butter as well as in starter cultures. Unfortunately few investigations were conducted regarding, keeping both diacetyl and acetoin contents in butter in desirable amounts without any deterioration, i.e., without being converted to 2,3-butylene glycol as a result of the activity of diacetyl reductase enzyme; possessed by spoilage organisms. Harmon (1969) reported that Bacillus, Pseudomonas, Escherichia, Aerobacter, Preteus and Alcaligenes as spoilage microorganisms; because of the diacetyl reductase they are able to possess.

The distribution of diacetyl reductase among spoilage bacteria was confirmed. Elliker (1945) and Parker et al. (1953) found that Alcaligenes metalcoligenes, Pseudomonas fragi and Pseudomonas viscosa converted the diacetyl to acetoin and possibly to 2,3-butylene glycol.

Seitz et al. (1963) recorded that spoilage bacteria have produced diacetyl reductase in certain units (unit being "activity of enzyme per milligram of enzyme protein"); being 345 units for Aerobacter aerogenes; 64 for Pseudomonas putrefaciens; 55 for Alcaligenes matalcaligenes; 44 for Pseudomonas fragi; 19 for Pseudomonas fluorescens; 5 for Escherichia coli and 3 for Pseudomonas viscosa. Seitz added that the reduction of diacetyl is irreversible one and suggested the following scheme to clear out this point of reaction :



Farahat (1967) investigated the diacetyl reductase along five strains : two were Str. lactis IAM 1049 ; 527 and the other three were Pediococcus soyae IAM 1673, 1692 and 1697. Pediococcus soyae IAM 1692 was found to be the most active possessing 49 units of diacetyl reductase enzyme, while Str. lactis 527 was inferior in activity, possessing only 9 units.

The presence of free fatty acids in butter is mainly due to the lipolytic activity of : (a) milk lipase and (b) microbial lipase; either intracellular or extracellular. Several investigations have studied the characteristics of milk lipase. Since bacteria has been widely applied in dairying, the attention has been drawn for studying the properties of microbial lipase. Shahani et al. (1964) found that the optimum hydrolysis for intracellular lipase of Achromobacter lipolyticum was at pH 8.0, but at pH 7.0 only 20% oleic acid was neutralized. They also gave 21°C as an optimum temperature. Khan et al. (1964) found that the optimum hydrolysis for extracellular enzyme of the mentioned strain was at pH 7.0 and the optimum temperature was 37°C.

The intracellular lipase prepared by Farahat (1967) from two strains of Streptococci and three strains of Pediococci proved to be very weak. The cultures of Str. lactis 527 and P. sojiae IAM 1673 were relatively stronger in lipase activity than other strains. The optimum temperature and pH of lipase given by the same author were 27°C and 7.5 - 8.5, respectively.

Elliker (1962) stated that the problem in question involves keeping quality of butter through our modern retail distribution systems, is the rapid spoilage due to

microbial growth and its by-products of flavour deterioration. Both fat and nitrogenous constituents of cream are subject to attack by microorganisms. The presence of both proteolytic and lipolytic microorganisms (transmitted from air, human, equipment, and packaging material) might mean rapid deterioration of resultant butter.

a) Air-borne and ventilation :

Minimizing contamination of any product from air-borne microorganisms is one of the most serious problems.

Contamination of milk and milk products by that source has been given little consideration in the past. This kind of contamination can greatly reduce the shelf-life of milk products. Most of work carried out on the effect of air-borne microorganisms was in hospitals and for medical military services. The distribution of certain microorganisms in air, as reported by Frankland (1887) was followed by a good number of investigations to develop adequate apparatus for collecting air-samples. Quantitative evaluation of air-borne microbiological particles was first investigated by Wells (1933), who used centrifugal forces to collect the particles on a solidified agar plate. That was then followed by several modifications. Among the more effective of these methods are : the casella slit sampler (Bourdillon et al., 1941) ;