

RHEOLOGY OF BATTER TYPE DOUGHS

SUBMITTED BY : Lazaros . D. Sasloglou

**A thesis submitted in partial fulfilment of the requirements for the degree of
Master of Science in Food Technology**

SUPERVISED BY: Dr . Evangelos . S . Lazos

**UNIVERSITY OF LINCOLNSHIRE & HUMBERSIDE
SCHOOL OF APPLIED SCIENCE AND TECHNOLOGY**

SEPTEMBER 1996

660-753
SAS

T.E.E. AGHIAE
DISAIOGNKH
CP. 910. 16857

RHEOLOGY OF BATTER TYPE DOUGHS

SUBMITTED BY : Lazaros . D. Sasloglou

**A thesis submitted in partial fulfilment of the requirements for the degree of
Master of Science in Food Technology**

SUPERVISED BY: Dr . Evangelos . S . Lazos

**UNIVERSITY OF LINCOLNSHIRE & HUMBERSIDE
SCHOOL OF APPLIED SCIENCE AND TECHNOLOGY**

SEPTEMBER 1996

ACKNOWLEDGEMENTS

I would like to thank my academic supervisor Dr. E. S. Lazos for his assistance and helpful advises.

I wish to acknowledge, the assistance of all academic, library and technical staff of the School of Applied Science and Technology, University of Lincolnshire and Humberside.

I also wish to thank my colleagues and roommates, Costas, Nectarios and Maria for the enjoyable staying in Grimsby, and special thanks to Vaso who gave me a big smile and encouragement whenever I needed.

Dedication

To my parents who brought me in life.

ABSTRACT

Batter-type doughs are viscoelastic with explicit, nonlinear shear thinning behaviour. The commonly used empirical and descriptive rheological methods determined the consistency and extensibility of doughs by applying large deformation forces in a single-point measurement. They were therefore not suitable to describe dough flow properties. Flow properties determined by basic rheological methods using a rotational viscometer. Flow behaviour and consistency indices can be described by the power law model. Both the flow and consistency indices were affected by the flour:water ratio of doughs and the addition of egg and milk in the pancakes. The range of consistency index values for the three types of flours for the different flour:water ratios at 10°C was from 47,798 to 1,577 mPas. At 20°C 37,573-1,438; at 30°C 24,120-1,341; at 40°C 20,596-1,161; at 50°C 15,156-769.2 and at 55°C from 68,446 to 5,031 mPas. The viscosity was increased by the addition of egg and decreased when milk was incorporated.

The effect of temperature was the same for all the mixtures. Any increase from 10°C to 50°C resulted in a decrease in viscosity while at 55°C-60°C the viscosity was increased.

The pancake mixture showed a shear-thickening dilatant behaviour with an average flow index of 1.623 compared with that of a commercial recipe of 0.779.

<u>CONTENTS</u>	PAGE NO
1. INTRODUCTION	3
2. BASICS OF RHEOLOGY	5
2.1. FACTORS AFFECTING VISCOSITY	11
2.2. COMMON RHEOLOGICAL INSTRUMENTS	16
3. DOUGH RHEOLOGY	18
3.1. EFFECTS OF DOUGH CONSTITUENTS	19
3.2. PHYSICAL DOUGH-TESTING INSTRUMENTS	28
3.3. EMPIRICAL AND IMITATIVE METHODS	30
3.4. FUNDAMENTAL TESTS	31
4. BATTERS	32
4.1. FORMULATION OF BATTER SYSTEMS	32
4.2. BATTER CHARACTERISTICS	34
4.3. FACTORS AFFECTING BATTER PROPERTIES	35
5. AIMS	46
6. MATERIALS AND METHODS	47
6.1. FLOUR ANALYSIS AND EVALUATION	47
6.2. DOUGH FORMULATION	48
6.3. RHEOLOGICAL MEASUREMENTS	49
6.4. CALCULATIONS	50
7. RESULTS AND DISCUSSION	51
7.1. FLOUR COMPOSITION AND PHYSICAL TESTING	51
7.2. RHEOLOGICAL MEASUREMENTS	57
8. CONCLUSIONS	75
9. SUGGESTION FOR FURTHER WORK	76
REFERENCES	77
APPENDIX	88