QUALITY EVALUATION OF SOME CEREAL PRODUCTS FROM NEW WHEAT VARIETIES

By

SEHAM YEHIA GEBRIEL SALLEH
B.Sc. Agric. Sc. (Food Science and Technology), Cairo University, 2001
M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2008

A thesis submitted in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY
In Agricultural Science (Food Science and Technology)

Food Science Department
Faculty of Agriculture
Ain Shams University

2015
QUALITY EVALUATION OF SOME CEREAL PRODUCTS FROM NEW WHEAT VARIETIES

By

SEHAM YEHIA GEBRIEL SALLEH

B.Sc. Agric. Sc. (Food Science and Technology), Cairo University, 2001
M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2008

This thesis for Ph.D. degree has been approved by:

Dr. Mohammed El-Anwar Othman …………………………………
Prof. of Food Science and Technology, Faculty of Agriculture, El-Azhar University

Dr. Ibrahim Rizk Sayed Ahmed……………………………………
Prof. Emeritus of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Dr. Nagwa Mousa Hassen Rasmy ……………………………………..
Prof. Emeritus of Food Science and Technology, Faculty of Agriculture, Ain Shams University

Dr. Hanan Mohamed Abdo Al-Sayed………………………………
Prof. of Food Science and Technology, Faculty of Agriculture, Ain Shams University.

Date of examination / / 2015
QUALITY EVALUATION OF SOME CEREAL PRODUCTS FROM NEW WHEAT VARIETIES

By

SEHAM YEHIA GEBRIEL SALLEH
B.Sc. Agric. Sc. (Food Science and Technology), Cairo University, 2001
M.Sc. Agric. Sc. (Food Science and Technology), Ain Shams University, 2008

Under the supervision of:

Dr. Nagwa Mousa Hassen Rasmy
Prof. Emeritus of Food Science and Technology, Dept. of Food Sci.,
Faculty of Agriculture, Ain Shams University (Principal Supervisor)

Dr. Hanan Mohamed Abdo Al-Sayed
Prof. of Food Science and Technology, Dept. of Food Sci., Faculty of
Agriculture, Ain Shams University.

Dr. Hoda Gharib El-Amry
Head Research of Food Science and Technology, Food Technology Res. Ins., Agricultural Research Center.
ABSTRACT


In this study, four soft wheat varieties (*T. aestivum*), i.e. Misr 1, Sids 12, Gemmiza 7 and Gemmiza 10, and two hard wheat varieties (*T. durum*), i.e. Beni Sweif 5 and Beni Sweif 1 and its fractions (whole meal, 82, 72% and semolina extraction) were evaluated for the physic-chemical and rheological properties to provide us with data that may employ as guidelines to produce some bakery products.

Beni sweif 5, Gemmiza 7 and Sids 12 grains varieties had a higher hectoliter and 1000 kernel weight than other tested varieties. However, hard wheat varieties characterized by high kernel hardness. Durum wheat flour varieties showed a higher yellowness values. This indicates the preferred color characteristics of durum wheat flour for pasta production. However, a slight difference in color values was observed between the bread wheat and durum wheat.

Results showed that Sids 12 and Beni sweif 5 varieties and its fractions had high protein and low total carbohydrate contents compared to other tested samples. Wheat variety Beni sweif 5 and Sids 12 contained relatively higher EAA and NEAA contents compared to other wheat varieties. All wheat verities are rich in unsaturated fatty acids particularly of linoleic acid (C18:2) content. New wheat variety Sids 12 had the highest Mg, Ca, Zn and Mn content (108.6, 359.8, 4.88 and 3.90 mg/100g, respectively).

Hard whole meal of Beni sweif 5 had significantly the highest β-carotene (8.31ppm) and tannins content (28.60 mg/100g) and their quantity were decreased as the extraction rate decrease. Also, the whole wheat meal contained higher phytic acid than refined flours (82 and 72% extraction)
Sids 12 and Gemmiza 7 whole meal had significantly the highest TPC (166.08 and 162.20 mg gallic /100g respectively), while Beni sweif 1 had the lowest TPC (124.76).

It was found that wheat flour dough Beni sweif 5 recorded the highest value of stability (8.5 min and 4.5 min. for 72 and 82% ext. respectively), but recorded low value of degree of softening (20 and 80 B.U. for 72 and 82%, respectively). Wheat flour dough Beni sweif 5 recorded the highest values of resistance to extension (480 and 290 B.U. at 72 and 82%, respectively), while wheat flour dough Gemmiza 10 and Misr 1 had the highest extensibility values.

Different wheat flour extractions samples and their blends were used to prepare and evaluate different wheat products (i.e. chapatti bread, balady bread, pan bread and macaroni).

Chapatti bread prepared from whole meal of Beni sweif 5 is distinguished by a significant high amount of protein (13.95%) and ash (1.79%) and low carbohydrate content (79.38%). In conclusion, it could be recommended the use of whole meal of new Egyptian wheat variety of Sids 12 and Beni sweif 5 and the blends of B5 with S12 or G10 for production chapatti bread.

Balady bread made from wheat flour 82% ext. Sids 12 recorded the highest value of protein followed by Beni sweif 5 and Misr 1. Bread loves of Beni sweif 5 durum wheat showed less change in moisture content per day than soft wheat. Balady bread prepared from new varieties Beni sweif 5 durum wheat flour recorded the highest score for overall acceptability followed by Sids 12 and Misr 1.

Protein contents in pan bread samples ranged from 12.86 (Beni Sweif 1 72% ext.) to 14.97% (Beni Sweif 5 72%). Pan bread prepared from old variety Gemmiza 7 flour recorded the highest total scores (97.99), followed by new varieties of Sids 12 and Misr 1 (96.98 and 96.48 respectively).

Macaroni which prepared from semolina of new variety Beni sweif 5 recorded the highest content of protein, ash and crude fiber and the
highest overall acceptability in comparison with that of semolina of old variety of Beni sweif.

**Key words:** Soft Wheat, Durum Wheat, Extraction Rate, Wheat Flour, Physical Properties, Chemical Analysis, Amino Acids, Fatty Acids, Minerals, Heavy Metals, Phytochemical, Bakery Products, Chapatti Bread, Balady Bread, Pan Bread, Macaroni.
ACKNOWLEDGMENT

All praises are due to Allah, who blessed me with kind professors and colleagues, and gave me the support to produce this thesis.

I wish to express my grateful appreciation and deepest thanks to Prof. Dr. Nagwa M.H. Rasmy, professor of Food Science and Technology, Food Sci. Dep., Fac. of Agric., Ain shams university for her direct supervision, greatest faithful, constructive criticism, valuable discussion and plentiful active for me to bring this investigation to its best shape.

Deepest thanks and sincere appreciation to Dr. Hanan M.A. Al-Sayed professor of Food Science and Technology, Food Sci. Dep., Fac. of Agric., Ain shams university for her direct supervision, careful guidance, willing cooperation, and valuable assistance and continuous encouragement throughout the time of this study.

I would like to express my deepest thanks to Prof. Dr. Hoda G. El-Amary professor of Food Science and Technology, Food Technology Res. Ins., Agricultural Research Center for her supervision, valuable help throughout this work, and her unlimited help during preparing this thesis.

Thanks also extended to the all staff members and colleagues in the Food Sci. Dep., Fac. of Agric., Ain Shams University and in the Food Technology Res. Ins., Agricultural Research Center.
LIST OF CONTENTS

No | LIST OF TABLES | Page | LIST OF FIGURES | Page | LIST OF APPRIVIATIONS | Page
---|---|---|---|---|---|---
Vi | ix | X
1. | INTRODUCTION | 1
2. | REVIEW OF LITERATURE | 5
2.1. | Wheat grains | 5
2.1.1. | Wheat varieties | 7
2.1.2. | Physical properties of different wheat varieties | 8
2.1.3. | Chemical composition of wheat kernel and their flours | 11
2.2. | Phytochemicals in wheat grains | 21
2.2.1. | β-carotene content | 21
2.2.2. | Tannin content | 22
2.2.3. | Phytic acid content | 23
2.2.4. | Total phenolic compounds | 24
2.3. | Rheological properties of different wheat flour dough: | 25
2.4. | Wheat flour Processing: | 33
2.4.1. | Chapatti bread | 34
2.4.2. | Balady bread | 37
2.4.3. | Pan bread | 40
2.4.4. | Macaroni | 42
3. | MATERIALS AND METHODS | 44
3.1. | Materials | 44
3.1.1. | Wheat varieties | 44
3.1.2. | Chemicals | 44
3.2. | Methods | 44
3.2.1. | Preparation of wheat samples for milling | 44
3.2.2. | Analytical methods of wheat varieties | 45
3.2.2.1. | Physical analysis | 45
3.2.2.1.1. | Cleanliness and Shrunken and broken kernels | 45
3.2.2.1.2. Hectoliter (Kg / hl) 45
3.2.2.1.3. Thousand kernel weight 45
3.2.2.1.4. Hardness 45
3.2.2.1.5. Kernel length and width 46
3.2.2.1.6. Color determination 46
3.2.2.2. Chemical analysis 46
3.2.2.2.1. Proximate chemical composition 46
3.2.2.2.2. Gliadins and glutenins contents (by protein fraction method) 46
3.2.2.2.3. Amino acids 47
3.2.2.2.4. Fatty acids 47
3.2.2.2.5. Minerals content 48
3.2.2.2.6. Heavy metals 48
3.2.2.2.7. β-carotene content 49
3.2.2.2.8. Tannins content 49
3.2.2.2.9. Phytic acid content 49
3.2.2.2.10. Total phenols 50
3.2.3. Rheological properties of wheat flour samples: 50
3.2.3.1. Farinograph test 50
3.2.3.2. Extensograph test 51
3.2.3.3. Wet and dry gluten 51
3.2.3.4. Sedimentation test 52
3.2.3.5. Falling Number 53
3.2.4. Technological processing 53
3.2.4.1. Chapatti processing 54
3.2.4.2. Balady bread processing 54
3.2.4.3. Pan bread processing 55
3.2.4.4. Macaroni processing 55
3.2.5. Quality evaluation of wheat varieties products 56
3.2.5.1. Physical analysis 56
3.2.5.2. Determination of bread staling 56
3.2.5.3. Cooking quality of spaghetti 57
3.2.6. Sensory evaluation of wheat varieties products 58
3.2.6.1. Sensory evaluation of chapatti 58
3.2.6.2. Sensory evaluation of balady bread 58
3.2.6.3. Sensory evaluation of pan bread 58
3.2.6.4. Sensory evaluation of cooked macaroni 58
3.2.7. Statistical analysis 60

4. RESULTS AND DISCUSSION 61
4.1. Physical properties of wheat kernels 61
4.2. Color of different wheat kernel varieties and its fractions. 64
4.2.1. Color of different wheat kernel 65
4.2.2. Color of different wheat flour (82% extraction) 67
4.2.3. Color of different wheat flour (72% extraction) 67
4.2.4. Color of semolina extraction 70
4.3. Chemical constituents of different wheat varieties and its fractions 72
4.3.1. Chemical composition 72
4.3.1.1. Whole meal 72
4.3.1.2. Wheat flour (82% extraction) 74
4.3.1.3. Wheat flour (72% extraction) 77
4.3.1.4. Semolina extraction 79
4.3.2. Amino acid content of different wheat varieties 81
4.3.2.1. Essential amino acid content 81
4.3.3. Fatty acids content of different wheat varieties 85
4.3.4. Minerals and trace elements of different wheat varieties. 88
4.3.5. Heavy metals of different wheat varieties 90
4.4. Phytochemicals composition of different wheat varieties and its fractions 92
4.4.1. β-carotene content 92
4.4.2. Tannins content 94
4.4.3. Phytic acid content 95
4.4.4. Total phenolic compounds (TPC) 98
4.5. Rheological properties of wheat flour dough 101
4.5.1. Farinograph parameters of different wheat flour dough (72 and 82% ext.) 101
4.5.2. Extensograph parameters of wheat flour dough (72 and 82% extraction) 104
4.5.3. Gluten content of wheat flour dough (72 and 82% ext.) 105
4.5.4. Gluten fractions of wheat flour dough (72% extraction) 108
4.9.5. Sedimentation test of wheat flour (whole meal, 82, and 72% extraction) and semolina 108
4.5.6. Falling number of wheat flour (whole meal, 82, and 72% extraction) and semolina 111
4.6. Production of some products from new wheat varieties extractions 112
4.6.1. Production of chapatti bread from different varieties of whole wheat meal flour 112
4.6.1.1. Chemical composition of chapatti bread 113
4.6.1.2. Sensory evaluation of chapatti bread 115
4.6.2. Production of balady bread from different wheat varieties flour (82% extraction) 117
4.6.2.1. Chemical composition of balady bread 118
4.6.2.2. Staling of balady bread 120
4.6.2.3. Sensory evaluation of balady bread 122
4.6.3. Production of pan bread from different wheat varieties flour (72% extraction) 124
4.6.3.1. Chemical composition of pan bread prepared 124
4.6.3.2. Physical properties of pan bread 126
4.6.3.3. Staling of pan bread 128
4.6.3.4. Sensory evaluation of pan bread prepared from wheat flour varieties (72% ext.) 130
4.6.4. Production of macaroni from durum wheat semolina 133
4.6.4.1. Chemical composition of macaroni 133
4.6.4.2.  Quality properties of macaroni  135
4.6.4.3.  Firmness of macaroni  138
4.6.4.4.  Sensory evaluation of macaroni durum  153

5.  SUMMARY AND CONCLUSION  156

6.  REFERENCES  167
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>Percentage</td>
</tr>
<tr>
<td>°C</td>
<td>Centigrade degree</td>
</tr>
<tr>
<td>µg</td>
<td>Microgram</td>
</tr>
<tr>
<td>AACC</td>
<td>American Association of Cereal Chemists</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>AOAC</td>
<td>Association of Official Agricultural Chemists</td>
</tr>
<tr>
<td>AWRC</td>
<td>Alkaline Water Retention Capacity</td>
</tr>
<tr>
<td>B.U.</td>
<td>Brabender unit</td>
</tr>
<tr>
<td>Ca</td>
<td>Calcium</td>
</tr>
<tr>
<td>Cd</td>
<td>Cadmium</td>
</tr>
<tr>
<td>Cm</td>
<td>Centimeter</td>
</tr>
<tr>
<td>Co</td>
<td>Cobalt</td>
</tr>
<tr>
<td>Cr</td>
<td>Chromium</td>
</tr>
<tr>
<td>D.F.</td>
<td>Dietary fiber</td>
</tr>
<tr>
<td>Da</td>
<td>Dalton</td>
</tr>
<tr>
<td>Dwt</td>
<td>Dry weight</td>
</tr>
<tr>
<td>E</td>
<td>Extensibility</td>
</tr>
<tr>
<td>e.g.</td>
<td>For example</td>
</tr>
<tr>
<td>Ed</td>
<td>Editor</td>
</tr>
<tr>
<td>et al</td>
<td>And others</td>
</tr>
<tr>
<td>Ext.</td>
<td>Extraction</td>
</tr>
<tr>
<td>F.N</td>
<td>Falling Number</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>Fe</td>
<td>Iron</td>
</tr>
<tr>
<td>Fig.</td>
<td>Figure</td>
</tr>
<tr>
<td>g</td>
<td>Gram</td>
</tr>
<tr>
<td>hr.</td>
<td>Hour</td>
</tr>
<tr>
<td>i.e.</td>
<td>That is (id est)</td>
</tr>
<tr>
<td>J</td>
<td>Journal</td>
</tr>
<tr>
<td>K</td>
<td>Potassium</td>
</tr>
<tr>
<td>Keal</td>
<td>Kilocalorie</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>mg</td>
<td>Milligram</td>
</tr>
<tr>
<td>Mg</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Min.</td>
<td>Minute</td>
</tr>
<tr>
<td>ml</td>
<td>Milliliter</td>
</tr>
<tr>
<td>Mn</td>
<td>Manganese</td>
</tr>
<tr>
<td>Mt</td>
<td>Million ton</td>
</tr>
<tr>
<td>N</td>
<td>Newtton</td>
</tr>
<tr>
<td>N.D</td>
<td>Not detected</td>
</tr>
<tr>
<td>Na</td>
<td>Sodium</td>
</tr>
<tr>
<td>NFE</td>
<td>Nitrogen free extract</td>
</tr>
<tr>
<td>Ni</td>
<td>Nickel</td>
</tr>
<tr>
<td>No.</td>
<td>Number</td>
</tr>
<tr>
<td>P</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>Pb</td>
<td>Lead</td>
</tr>
<tr>
<td>R</td>
<td>Resistant to extension</td>
</tr>
<tr>
<td>Resp</td>
<td>Respectively</td>
</tr>
<tr>
<td>S.F.A</td>
<td>Saturated fatty acids.</td>
</tr>
<tr>
<td>Sci.</td>
<td>Science</td>
</tr>
<tr>
<td>SDS</td>
<td>Sodium dodecyl sulfate</td>
</tr>
<tr>
<td>Sec.</td>
<td>Second</td>
</tr>
<tr>
<td>TCA</td>
<td>Tri-chloro acetic acid</td>
</tr>
<tr>
<td>TDF</td>
<td>Total dietary fiber</td>
</tr>
<tr>
<td>TEAA</td>
<td>Total essential amino acids.</td>
</tr>
<tr>
<td>TNEAA</td>
<td>Total non essential amino acids.</td>
</tr>
<tr>
<td>U</td>
<td>Unit</td>
</tr>
<tr>
<td>U.S.</td>
<td>United states</td>
</tr>
<tr>
<td>UnS.F.A</td>
<td>Unsaturated fatty acids.</td>
</tr>
<tr>
<td>UV</td>
<td>Ultraviolet</td>
</tr>
<tr>
<td>V</td>
<td>Volume</td>
</tr>
<tr>
<td>WHO</td>
<td>World health organization</td>
</tr>
<tr>
<td>Zn</td>
<td>Zinc</td>
</tr>
<tr>
<td>β</td>
<td>Beta</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

Wheat (*Triticum aestivum L. em Thell.*) is the first important and strategic cereal crop for the majority of world’s populations. It is the most important staple food of about two billion people (36% of the world population). Worldwide, wheat provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally (*Breiman and Graur, 1995*). It exceeds in acreage and production every other grain crop (including rice, maize, etc.) and is therefore, the most important cereal grain crop of the world, which is cultivated over a wide range of climatic conditions and the understanding of genetics and genome organization using molecular markers is of great value for genetic and plant breeding purposes. Wheat varieties are classified into different classes which exhibit different applications. Those varieties differed in quantity and quality of proteins, mainly gluten. Wheat flour gluten results mainly the unique properties of dough (*Nowotna et al., 2003*).

In Egypt, there is a gap between production and consumption of wheat. According to the limited area of cultivated land and the rapid increase in population, local production of soft wheat flour covers only 50% of consumer needs. This forced the government to import large quantities of wheat to solve the problem of insufficient local production and to cover the requirements of balady bread production (*Mekhael, 2005*). Many serious attempts have been made to narrow this gap. e.g. enhancing the yield/feddan, breeding higher yield varieties and blending of wheat flour with non-wheat cereals. In spite of all these efforts, we still import quite large amounts of wheat (*Mohy El-Din, 2004*). Therefore, In Egypt National Program for Wheat Research developed new wheat varieties characterized with its higher yield and persist pests, i.e. Misr 1, Sids 12, Gemmiza 10 and Beni sweif 5 (*Anonymous., 2005*).

Annual global wheat production exceeds 723.4 million tones, making the world wheat market valuable (*FAO, 2014*). The total area and production of wheat in 2013/2014 in Egypt were 3.5 million feddan, and 8.3 million tons, respectively. In 2014, 17.6 million tons of different