International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 8, Issue 7 -2021

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.07.016

Physico-chemical characteristics of the wheat flour are suitable for the biscuit manufacturing process

[1]B.M. Manjunatha, [2*]N. Supraja, [3]B. Vijayakumar

[1]Department of Dairy Engineering, College of Diary Technology, Sri Venkateswara Veterinary University, Tirupati - 517502
[2*]Acharya N G Ranga Agricultural University, Nanotechnology Laboratory, RARS, Tirupati - 517501
[3]Hi-Tech Life Science Pvt Ltd, Nellore - 524001

Abstract

Biscuits are one of the most consumed bakery products eaten by everyone. Among these are, growth in population, changes in its composition and location, growth in personal incomes, relative costs of frozen verses other forms of foods, change in food tastes and preferences. Continued expansion of the industry will depend largely on the ability of handlers and distributors or maintain high standards of appearance, flavor, and nutritive value of the frozen foods, and to continue to secure a satisfactory return on their investment. Improvement in merchandising, promotion and development of new convenience forms of frozen foods, as well as more information on relative costs and nutritive value of frozen foods, will contribute towards continued growth of the industry. The aim of this work was to produce a preparation of biscuit from frozen dough and identify the Physico chemical characteristics of the wheat flour are suitable for biscuit making.

Keywords: Wheat flour, Chemical Characteristics, Physical Characteristics

1. Introduction

Wheat (*Triticum aestivum*) grains are mainly used for the production of wheat flour. It provides substantial nutrients in human diet and brings huge economic benefits to the growers and manufacturers (Shewry & Hey, 2015). Wheat flour has unique functional characteristics in food manufacturing. These characteristics are attributed to mainly two fundamental macromolecular components. Those are protein (gluten), which is responsible for forming dough into bread, and starch, which is the main non-structural carbohydrate naturally found in cereal grains. Starch is the major component of wheat kernel as it contributes 54-72% of dry weight. It is packed in endosperm as small microscopic particle which is known as starch granule (Elvers & Ullmann, 2017). Distinct populations of starch granule lead to variation in shape, size and physicochemical properties (Pfister & Zeeman, 2016). Wheat starch displays a bimodal starch distribution, which can be classified into A-type (large) starch granules and B-type (small) starch granules. Both types have different morphology, amylose content, relative crystallinity and microstructure, therefore leading to variation in thermal, swelling, and rheological properties (Koehler & Wieser, 2012).

The quality and functionality of wheat flour are commonly profiled by using standardized methods. Solvent retention capacity (SRC) test is a solvation test that reveals the swelling behavior of each functional polymeric components in wheat flour, such as damaged starch, gluten protein (glutenin and gliadin) and arabinoxylan (pentosan) (Kweon et al., 2011). Besides, gluten performance index (GPI) is usually measured using the data of SRC to estimate the overall performance of gluten in wheat flour. These information are commonly used to categorize hard and soft wheat flours with different chemical and functional properties. Furthermore, the functional properties of wheat flour products can be affected by the overall proportion of two types of D-glucose polymers in the starch granules, which are amylose and amylopectin (Sramkova et al., 2009). In general, wheat starch comprises 25-28% of amylose and 72-75% of amylopectin. Amylose is a linear polysaccharide with α-(1-4)-linked molecules with very few branch points. It is mainly found in the amorphous region of starch, which involves water absorption inhibition, plasticization of starch granules and chemical activities (Sissons, 2016).

Biscuits are a ubiquitous snack food that many people are unable to resist eating because they are readily available, are bite-sized, are affordable, and have a long shelf-life. As a result, biscuits are highly favored bakery items (Caleja et al., 2017). They cannot, however, be regarded as a healthy snack food because they usually contain high levels of easily digested carbohydrates and fats, generally low levels of fiber, and only modest levels of protein as they are usually made from flour, butter, and sugar (Park et al., 2015). Recent trends suggest that people are aware of the food they consume and they are also aware of benefits of consuming nutritious biscuits (Yeh et al., 1998).

The development of a high-protein-containing biscuit is a worthwhile challenge when considering the overall nutritional status of underprivileged sections of the population. In considering the development of a new product, it is important to use locally sourced ingredients and spices whose tastes are appreciated by each ethnic group the products are intended. Commercial green-lipped mussels (Perna canaliculus) are popular as raw materials and dietary supplements because they contain high protein levels, omega-3 fatty acids, iodine, and carbohydrates (Grienke et al., 2014). In addition, mussels contain proteins, peptides, and amino acids which are bioactive compounds. The manufacture of glutenfree pasta mixed with different levels of green-lipped mussel powder has been studied by (Vijaykrishnaraj et al., 2015) and later by (Vijaykrishnaraj et al., 2016) who made gluten-free bread enriched with different levels of green mussel protein hydrolysates.

Therefore, this study was conducted to analyze the physico-chemical and quality characteristics of Wheat flour to prepare nutritious biscuits to deliver a nutritious and healthy product. It is important, however, to understand the response of different ethnic groups to this new product

2. Materials and Methods

2.1 Wheat Flour

Wheat flour was procured from the local market (TV Brand).It was sieved before use, stored in air tight container.

2.2 Sugar Powder

Sugar powder (Harry's Pvt. Ltd., Mysore) was procured from local market and stored.

2.2.a Shortening

Marvo, a vegetable bakery shortening (manufactured by Hindustan Lever Ltd., Mumbai) was used.

2.2.b Skim Milk Powder

'Sagar' brand skim milk powder (Gujrat Co-operative milk MarketingFederation) was puschased and used.

2.2.c Emulsifier

Glycerol Monostearate and SodiumStearyl Lactylate paste was prepared by mixing 0.5g in 2.0ml of worm water and used.

2.2.d Gum

Guar gum was procured from local market and used.

2.2.e Minor Ingredients

Food grade Sodium chloride, Sodium bicarbonate, Ammonium bicarbonate,Glucose, and vanilla flavor was used in the preparation of biscuit.

2.3 Chemical Characteristics of Wheat Flour

Moisture (AACC method, 44-19), total ash (AACC method, 08-01), Hag berg falling number (AACC method, 56-80), wet and dry gluten (AACC method, 38-10), damaged starch (AACC method, 08-01), Zeleny's sedimentation value (AACC method, 08-01) were determined in wheat flour according to standard methods.

2.3. a Moisture content

Two grams of flour sample was weighed in an aluminum dish using a Mettler balance and placed in an air oven maintained at 130±1ºC for 1 hour. It was cooled to room temperature in a desiccator and the loss in weight in percentage was reported as moisture content using the following formula.

$$\text{Moisture content (\%)} = \frac{(W1-W2)}{(W1-W)} \times 100$$

Where,
W = weight of empty dish, g
W1 = weight of dish + flour before drying, g
W2 = weight of dish + flour after drying, g

2.3.b Ash content

Ten grams of flour sample was weighed in a silica crucible and was incinerated over a burner until smoke ceases, kept in muffle furnace at 575 - 590ºC for 6 – 8 hours. The amount of mineral residue of ash is expressed as percentage of the original sample.

$$\text{Ash content (\%)} = \frac{C - B}{A - B} \times 100$$

Where,
A = weight of the silica crucible + sample before ashing, g
B = weight of the silica crucible, g
C = weight of the silica crucible + sample after ashing, g

2.3. c Gluten content

Exactly 25g of the flour is kneaded with about 15ml water to get a dough ball. The dough ball is then allowed to remain immersed in water for 1 hour to ensure proper hydration after which, the starch is washed out by kneading gently in a stream of water over a fine sieve till the washed liquid is clear. The gluten being cohesive is pressed as dry as possible and weighed for wet gluten. The wet gluten obtained is dried at 100ºC for 24 hours and weighed again to get the value for dry gluten.

$$\text{Wet gluten (\%)} = A/C \times 100$$
$$\text{Dry gluten (\%)} = B/C \times 100$$

Where, A = Weight of wet gluten, g
B = Weight of dry gluten, g
C = Weight of flour, g

2.3. d Falling Number

Weigh 7.0g of sample and place in falling number tube. Add 25ml of water. Insert rubber stopper and shake tube in upright position 20 times and make sure all flour is suspended in water. Place the tube in falling number boiling water bath and start the timer. The stirrer automatically stirs the flour suspension for 60 sec. The apparatus gives a buzzer and records time as falling number on the completion of stirrer falling a fixed distance through the liquefied gel. Falling number is inversely proportional to α – amylase activity of flour.

2.3. e Zeleny's sedimentation value

Place 3.2g of flour in 100ml Stoppard graduated cylinder. Add 50ml of water containing bromophenol blue. Mix thoroughly by moving the cylinder horizontally 12 times. Start the timer and place the cylinder on shaker for 5 minutes. Remove the cylinder and add 25ml of isopropyl – lactic acid salt reagent. Place the cylinder again on the shaker for 5 minutes. Remove the cylinder from the shaker and keep cylinder in upright position for exactly 5 minutes at the end of 5 minutes read the volume in ml.

Sedimentation value (14% basis) =

$$\text{Sedimentation value uncorrected} \times \frac{100-14}{100 - \text{original flour moisture}}$$

2.3. f Damaged starch

1g of the sample was taken with 45 ml of the α – amylase solution at 30ºC. Shaken well to get uniform suspension and incubated for 15 minutes at 30ºC. Add 3 ml of sulphuric acid and 2 ml of sodium tungstate, allowed to stand for 1 to 2 minutes and filtered. 5 ml of filtrate was transferred to a 100 ml boiling tube containing 10 ml of 0.1 N potassium ferricyanide. Kept in boiling water bath for 20 minutes, cooled and 25 ml acetic acid salt solution was added and titrated against 0.1 N sodium thiosulphate using starch and potassium iodide as indicator.

% Damaged starch = mg maltose / 10g flour x 1.64 x 5 / 100

2.4 Biscuit making procedure

The making of biscuits was carried out using the following method

- Cream sugar powder, fat, skim milk powder, glucose, and flavor (1st speed – 1 min, 2nd speed – 1 min and 3rd speed – 4 min).
- Dissolve salt, ammonium bicarbonate, and sodium bicarbonate separately in part of water and then add to cream (1st speed – 1 min, 2nd speed – 1 min and 3rd speed – 4 min).
- Add flour and mix for 2 minutes in 1st speed.
- Sheet the dough and cut into round shape.
- Bake at 200ºC for 5 to 6 minutes.
- Cool and evaluate the following.

    - Weight (g)
    - Diameter (mm) - D
    - Thickness (mm) - T
    - Spread ratio – D/T
    - Density (g/mm³)

Results and Discussion

3.1 Flour characteristics

Chemical characteristics of wheat flour are presented in (Table.1). The gluten and protein contents of wheat flour indicated that the values are in the range suitable for biscuit making. The sedimentation value of 22.3 ml, which indicate quality and quantity of protein, showed that the flour is suitable for biscuit making. The ash content of flour indicated that the flour extraction is normal. The falling number value showed that the α – amylase activity is low.

The physico chemical characteristics showed that the wheat flour is suitable for soft dough biscuit making **(**Zhang et al., 2016).

Table 1: Flour analysis

Chemical Characteristics	Value
Moisture (%)	10.7
Ash (%)	0.57
Falling number	643
Wet gluten (%)	26.4
Dry gluten (%)	9.65
Sedimentation value (ml)	22.3
Damaged starch (%)	10.6

3.2 Physical characteristics

Effect of additives on the Physical characteristics of biscuits are Physical characteristics of biscuits with different additives are presented in (Table. 2)

Increase in diameter was observed in case of 0.5% GMS, 0.5% SSL, and combinations (0.25% GMS and 0.25% SSL) when compare with 0.5% guar gum and control.

Thickness decreased with addition of additives. The maximum decrease in thickness was observed in case of 0.25% GMS and 0.25% SSL.

Density decreased with addition of additives. The maximum decrease in thickness was observed in case of 0.5% SSL.

Breaking force increased in case of biscuit with 0.5% guar gum. The minimum breaking force was observed in case of 0.5% SSL (Sarabhai and Prabhasankar. 2015).

Table 2: Effect of additives on the Physical characteristics of Biscuit

Sample	Diameter (cm)	Thickness (cm)	Density (g/m^3)	Breaking force (gf)
Control	57.1 [bc]	6.2 [a]	558.6 [a]	1550 [a]
GMS (0.5%)	58.4 [a]	5.2 [c]	552.0 [c]	1220 [d]
SSL (0.5%)	58.7 [a]	5.1 [c]	454.5 [e]	1135 [d]
GMS (0.25%) + SSL (0.25%)	58.5 [a]	4.9 [c]	482.3 [d]	1397 [cd]
Gum (0.5%)	56.5 [c]	6.3 [a]	554.7 [b]	1600 [a]
GMS (0.25%) + SSL (0.25%) + Gum (0.5%)	57.6 [b]	5.8 [b]	551.6 [c]	1452 [b]
SEM a(±)	0.08	0.02	1.1	9.2

GMS: Glycerol Monostearate
SSL: Sodium Stearoyl Lactylate
Values for a particular column followed by different letters differ significantly ($p<0.05$)
[a]Standard error of mean at 18 degree of freedom

Conclusions

In summary, the morphological, thermal and physicochemical properties of four commercial wheat flours were reported and their quality attributes were discussed. Physico chemical characteristics of the wheat flour are suitable for biscuit making.SSL and combination of SSL & GMS improved the dough extensibility showing improvement in dough characteristics.SSL, GMS and combinations are beneficial for frozen dough biscuit.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

Acknowledgments

The authors were thankful to Dairy technology and Hi-Tech Pharma for supporting and involved in this research work.

References

Shewry, P., & Hey, S. (2015). The contribution of wheat to human diet and health. *Food and Energy Security*, 4(3), 178-202. http://dx.doi.org/10.1002/fes3.64 PMid:27610232.

Elvers, B., & Ullmann, F. (2017). Ullmann's food and feed Weinheim: John Wiley & Sons.

Pfister, B., & Zeeman, S. C. (2016). Formation of starch in plant cells. *Cellular and Molecular Life Sciences*, 73(14), 2781-2807. http://dx.doi.org/10.1007/s00018-016-2250-x PMid:27166931.

Koehler, P., & Wieser, H. (2012). Chemistry of cereal grains. In M. Gobbetti & M. Gänzle. Handbook on Sourdough Biotechnology (pp. 11-45). US: Springer.

Kweon, M., Slade, L., & Levine, H. (2011). Solvent Retention Capacity (SRC) testing of wheat flour: Principles and value in predicting flour functionality in different food processes and in wheat breeding - A review. *Cereal Chemistry*, 88(6), 537-552. http://dx.doi.org/10.1094/CCHEM-07-11-0092

Sramkova, Z., Gregova, E., & Sturdik, E. (2009). Chemical composition and nutritional quality of wheat grain. Acta Chimica Slovenica, 2(1), 115-138.

Sissons, M. (2016). Durum wheat chemistry and technology Elsevier Science: Amsterdam.

C. Caleja, L. Barros, A. L. Antonio, M. B. P. P. Oliveira, and I. C. F. R. Ferreira, "A comparative study between natural and synthetic antioxidants: evaluation of their performance after incorporation into biscuits," Food Chemistry, vol. 216, pp. 342–346, 2017.

J. Park, I. Choi, and Y. Kim, "Cookies formulated from fresh okara using starch, soy flour and hydroxypropyl methylcellulose have high quality and nutritional value," LWT-Food Science and Technology, vol. 63, no. 1, pp. 660–666, 2015.

L.L. Yeh, K. O. Kim, P. Chompreeda, H. Rimkeeree, N. J. N. Yau, and D. S. Lundahl, "Comparison in use of the 9- point hedonic scale between Americans, Chinese, Koreans and 1ai," Food Quality and Preference, vol. 9, no. 6, pp. 413–419, 1998.

U. Grienke, J. Silke, and D. Tasdemir, "Bioactive compounds from marine mussels and their effects on human health," Food Chemistry, vol. 142, pp. 48–60, 2014.

M. Vijaykrishnaraj, S. B. Kumar, and P. Prabhasankar, "Green mussel (*Perna canaliculus*) as a marine ingredient to enrich gluten free pasta: product quality, microstructure and biofunctional evaluation," Journal of Food Measurement and Characterization, vol. 9, no. 1, pp. 76–85, 2015.

N. Vijaykrishnaraj, B. S. Roopa, and P. Prabhasankar, "Preparation of gluten free bread enriched with green mussel (*Perna canaliculus*) protein hydrolysates and characterization of peptides responsible for mussel flavour," Food Chemistry, vol. 211, pp. 715–725, 2016.

Zhang, Y., Guo, Q., Feng, N., Wang, J., Wang, S., & He, Z. (2016). Characterization of A- and B-type starch granules in Chinese wheat cultivars. Journal of Integrative Agriculture, 15(10), 2203-2214. http://dx.doi.org/10.1016/S2095-3119(15)61305-3.

S. Sarabhai and P. Prabhasankar, "Influence of whey protein concentrate and potato starch on rheological properties and baking performance of Indian water chestnut flour based gluten free cookie dough," LWT-Food Science and Technology, vol. 63, no. 2, pp. 1301–1308, 2015.

Access this Article in Online

Quick Response Code	Website: www.ijarbs.com
	Subject: Food Technology

DOI:10.22192/ijarbs.2021.08.07.016

How to cite this article:

B.M. Manjunatha, N. Supraja, B. Vijayakumar. (2021). Physico-chemical characteristics of the wheat flour are suitable for the biscuit manufacturing process. Int. J. Adv. Res. Biol. Sci. 8(7): 146-151.

DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.07.016