www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(12): 652-657

www.thepharmajournal.com
Received: 05-09-2022
Accepted: 07-10-2022

Ramcharan Patel
Msc Scholar, JNKVV, Jabalpur, Madhya Pradesh, India

Shashi Gour
Scientist,
Directorate of Extention Services, JNKVV Jabalpur, Madhya Pradesh, India

Archana Panday
Senior Scientist,
Department of Food Science and Technology, Madhya Pradesh, India

Ishita Rajput
Msc Scholar, JNKVV Jabalpur, Madhya Pradesh, India

SS Shukla
Professor and Head,
Department of Food Science and Technology JNKVV, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Ramcharan Patel
Msc Scholar, JNKVV, Jabalpur, Madhya Pradesh, India

Hulless barley as a promising source to optimize level of different ingredients of cookies, using response surface methodology (RSM) technique

Ramcharan Patel, Shashi Gour, Archana Panday, Ishita Rajput and SS Shukla

Abstract
In this study, efforts were made to optimize hulless barley to enhance the nutritive value of cookies made from refined wheat flour. Hulless barley flour was added to refined wheat flour in different ratios (15 to 75%). Changes in quality and taste of cookies after blending of hulless barley flour with refined wheat flour were measured. Response surface methodology techniques were developed to study the effect of independent variables. The RSM approach was used to optimize ingredients in the cookies production using four factors as responses. A: RWF: HBF - 37.04, B: Sugar - 32.45, C: Guar gum - 3.23 and D: Ammonium bi-carbonate - 3.14 g/100g. The results obtained desirability in the present investigation actual factors indicated that better quality cookies. The efforts were also made to develop the technology for utilization of hulless barley as a novel ingredient in formulation of cookies. The model also explains the effect of ingredients on cookie characteristics.

Keywords: Hulless barley flour, RSM, cookies

Introduction
Cookies are very popular among all age groups, especially with children, as it holds a significant place in the baking industry due to variety in taste, texture and aroma. They are cereal based food products that generally contain three major ingredients; fat, flour, sugar; while some ingredients are aerating agents, flavouring agent, salt, and milk (Wade, 1988). Cookies have become one of the popular snack in the present time due to their low manufacturing cost, convenience, long shelf life, good eating quality also its ability to serve as a carrier for important nutrients (Hooda and Jood, 2005) [3]. Cookies are made in a wide variety of styles using an array of ingredients including sugars, spices, chocolate, butter, peanut butter, nuts or dried fruits. The softness of the cookie may depend on how long it is baked (Washeed *et al.*, 2010) [11]. Nowadays people are more concern about high fat – food products and obtain texture and flavour characteristics from the shortening used in the preparation of cookies (Florence *et al.*, 2014) [2]. Hulless barley *(Hordeum vulgare L.var nudum Hook. f.)* forms had a higher content of β-glucan, as well as a higher content of soluble dietary fibres than hulled forms (Fastnaught *et al.*, 1996) [1]. Therefore, need arises for replacing part of refined wheat flour with flour of hulless barley to encourage trends in consumption of bakery products by population of lower and middle income groups.

Materials and Methods
Hulless barley was purchased from market nimadganj mandi, near kamaniya gate, Jabalpur, Madhya Pradesh, whereas, refined wheat flour, sugar and other ingredients was purchased from local market of Jabalpur, Madhya Pradesh. Analytical grade chemicals were purchased online from Amazon shopping app. The materials like Vanaspati/ghee, was procured from bakery unit, Dept of Food Science and Technology, JNKVV, Jabalpur and were used for preparation of cookies. The potable water in the department was used to mix several mixes of wheat-barley flour and other materials for cookies development. The prepared cookies were packaged in High Density Polyethylene bags. These were purchased from M/s Satyam plastics, Jabalpur.

Equipment and machineries

The Department of Food Science and Technology JNKVV Jabalpur (MP) had all of the necessary equipment and machinery for product preparation and analysis. The following are the tools and machines that were utilised to conduct the experiment.

Table 1: Following machines and equipments were used in the research work

S. No.	Name of equipments/machine	Purpose	Source of Supply
1.	Electronic Weighing Balance	To measure the accurate quantity of raw materials, baking ingredients, chemicals and developed cookies.	M/S Supreti Traders Shop No 6 Methodist Center, Opp. Kartik Hotel Napier Town, Jabalpur (MP)
2.	Spiral Dough Mixer	To mix all the ingredients uniformly to form cohesive dough mass.	M/S Tajshree Bakery Machinery, Durga Nagar, Manewada Road, Nagpur
3.	Cookies Dropping Machine	For development of cookies.	F-4,5 & O-1, U.P.S.I.D.C. Industrial Area, Begrajpur, Muzaffarnagar-251203, UP, India
4.	Rotary Baking Oven	For baking of the cookies.	M/s HCS Enterprises Plot No 273, HSIIDC RAI Industrial Estate Sonipat, Haryana

Methodology

Preparation of Cookie: (Sabeeha Yaqoob *et al.*, 2017) [8] The cookies were prepared using following ingredients as per the traditional creaming process outlined in Table given below:

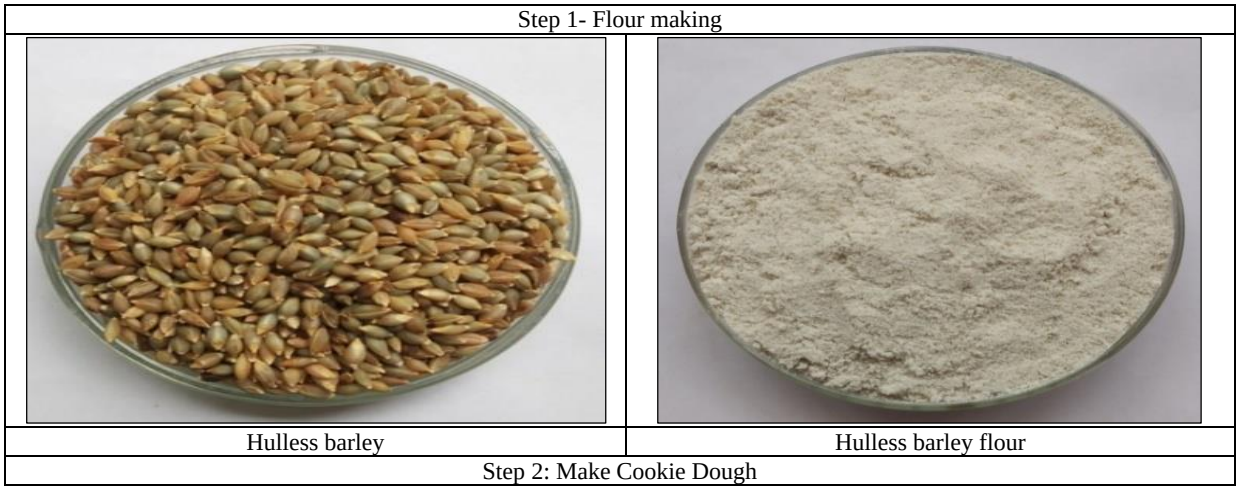
Table 2: Cookies from refined wheat flour (control sample)

Ingredients	Quantity
Refined Wheat flour (g)	100
Sugar (g)	50
Shortening (g)	40
Ammonium bicarbonate (g)	1
Guar gum powder (g)	3
Water (ml)	20

Nutrafoods (2017) 16:175-183 DOI 10.17470/NF-017-1002-3

Preparation of Ingredients (Weighing and Recipe calculation)
↓
Hydrogenated vegetable fat and powdered sugar mixed thoroughly in Mixture (5-8 min)
↓
Wheat flour + Hulless Barley flour (Mixed both the blends)
↓
Add Guar gum powder + ammonium bicarbonate
Mix Properly
↓
Dough forming with the addition of water and salt
↓
Put the dough in cookies dropper machine
↓
Developed cookies in tray
↓
Baking at 175ºC for 20 minute
↓
Cooling and Packaging
↓
Storage

Fig 1: Flow chart for preparation of hulless barley flour cookies



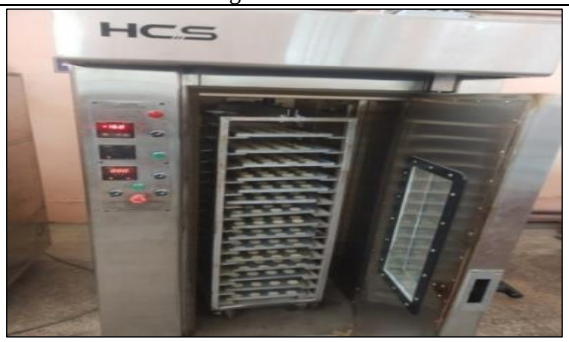

Weighing of ingredient (Shortening)


Weighing of ingredient (Hulless barley)


Mixing ingredients in spiral mixer


Pre baking of cookies machine

Developed cookies by cookies dropper



Baking of cookies in rotary oven


Baked cooieks


Packaging of cookies

Fig 2: Cookie making process

Experimental Design

The prime objective of study was to replace wheat flour with barley flour. There was also need of varying the proportion of other ingredients included in The ranges of variables were selected taking into consideration the maximum and minimum values used for control samples of preparation. Responses surface methodology (Mayer's, 1976) [6] was used to reduce the number of experiments, without affecting the accuracy of result. The experiment was planned in central composite rotatable the formulation for getting optimum quality of product. Thus, based on information available in the literature, four variables *viz*., wheat flour, hulless barley flour, sugar, guar gum powder and ammonium bicarbonate were selected for development of the formulation. Design with half replicate which consisted of 30 experiments. First 16 experiments in first order part, 8 experiments in second order part and next 6 experiments were at central point or replication.

Table 3: Experimental variables their coded and un-coded (actual) values for production of wheat and barley composite flour cookies

Variables	Unit	Code	Coded Levels				
			-2	-1	0	+1	+2
RWF:HBF	g	A	15	30	45	60	75
Sugar	g	B	25	30	35	40	45
Guar Gum	g	C	1.5	2.5	3.5	4.5	5.5
Ammonium bicarbonate	g	D	2.5	3.0	3.5	4.0	4.5

a: ±values, b: centre point, RWF – Refined Wheat flour, HBF – Hulless Barley flour

Table 4: Experimental design matrix for production of Wheat-Barley composite flour cookies

Coded Form					Un-Coded Form			
Expt. No.	A	B	C	D	RBF:HBF (g) A	Sugar (g) B	Guar gum (g) C	Ammonium bicarbonate (g) D
First Order Interaction								
1.	-1	-1	-1	-1	30	30	2.5	3
2.	1	-1	-1	-1	60	30	2.5	3
3.	-1	1	-1	-1	30	40	2.5	3
4.	1	1	-1	-1	60	40	2.5	3
5.	-1	-1	1	-1	30	30	4.5	3
6.	1	-1	1	-1	60	30	4.5	3
7.	-1	1	1	-1	30	40	4.5	3
8.	1	1	1	-1	60	40	4.5	3
9.	-1	-1	-1	1	30	30	2.5	4
10.	1	-1	-1	1	60	30	2.5	4
11.	-1	1	-1	1	30	40	2.5	4
12.	1	1	-1	1	60	40	2.5	4
13.	-1	-1	1	1	30	30	4.5	4
14.	1	-1	1	1	60	30	4.5	4
15.	-1	1	1	1	30	40	4.5	4
16.	1	1	1	1	60	40	4.5	4
Second Order Interaction								
17.	-2	0	0	0	15	35	3.5	3.5
18.	2	0	0	0	75	35	3.5	3.5
19.	0	-2	0	0	45	25	3.5	3.5
20.	0	2	0	0	45	45	3.5	3.5
21.	0	0	-2	0	45	35	1.5	3.5
22.	0	0	2	0	45	35	5.5	3.5
23.	0	0	0	-2	45	35	3.5	2.5
24.	0	0	0	2	45	35	3.5	4.5
Centre Point								
25.	0	0	0	0	45	35	3.5	3.5
26.	0	0	0	0	45	35	3.5	3.5
27.	0	0	0	0	45	35	3.5	3.5
28.	0	0	0	0	45	35	3.5	3.5
29.	0	0	0	0	45	35	3.5	3.5
30.	0	0	0	0	45	35	3.5	3.5

Statistical analysis

The data obtained from each experiment were processed on Dell i3 processor Laptop using Design Expert 11 statistical software. Response surface graphs of selected response were developed to study the effect of independent variables and to optimize the levels of ingredients. The findings of experiments are presented in subsequent chapter.

Results and discussion

In this study, the potential of hulless barley as health food was utilized to improve the nutritional and health benefits of wheat products (cookies). Indian barley genotypes have high variability in the β-glucan content (2.4–7.2%) (Kumar et al. 2012) [4]. BHS352, is a hulless barley genotype with high (6.5%) β-glucan content (Kumar et al. 2015) [5], antioxidant activity and phenolic content (Narwal et al. 2016) [7].

Wheat flour was mixed in different ratio with hulless barley flour to make cookies and evaluated for their β-glucan content, antioxidant activity and phenolic content. Wheat has the highest glutin content and has the highest biscuit spread factor among all the other Indian grains and thus used in this study (Online Resource 1, ESM1).

The central composite design of response surface methodology was used in this work to design a statistical model and to determine the optimal level of components for developing cookies. The impacts of the ingredients such as composite flour, shortening, sugar, guar-gum powder and ammonium bi-carbonate were studied individually and combinations. According to the RSM, the best appropriate model was a two-factor interaction (2FI) model.

Effect of barley on cookies quality

Hulless barley flour was mixed with refined wheat flour in different ratios (15–75%). The cookies were prepared and their quality scores were calculated. The quality score represents the overall quality of the cookies including physical, cooking and sensory parameters. It was observed

that more water was required to knead the dough with barley flour. Sharma and Gujral (2014b) [9] also reported increase in dough water absorption with the addition of barley flour. The change in the taste of the cookies started at 15% blending. The overall quality score of cookies for refined wheat flour decreased from 8.6 to 7.25 at 75% barley blending level, which was mainly due to slight change in colour and taste (Table 1). Thus, after 75% blending with barley, the cookies score decreased only by 15% and the cookies were still acceptable.

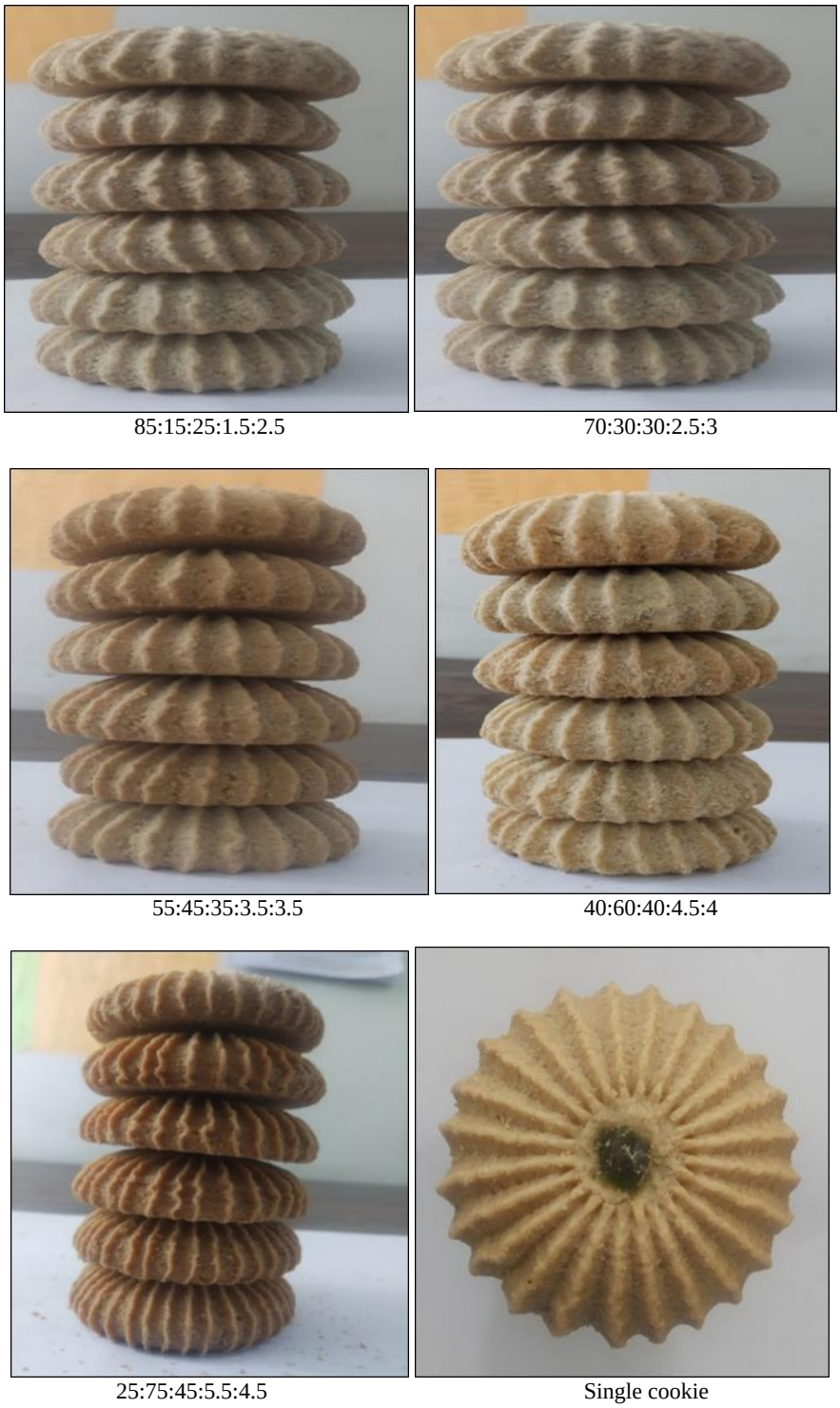


Fig 3: Prepared cookies in different ratio of refined wheat flour, hulless barley four, sugar, guar gum and ammonium bicarbonate

Optimized Values

The RSM approach was used to optimize ingredients in the cookies production using four factors as responses. A: RWF: HBF - 37.04, B: Sugar - 32.45, C: Guar gum - 3.23 and D: Ammonium bi-carbonate - 3.14 g/100g. The results obtained desirability in the present investigation actual factors indicated that better quality cookies. The efforts were also made to develop the technology for utilization of hulless barley as a novel ingredient in formulation of cookies.

Conclusion

The results clearly demonstrated that the models developed are appropriate and can be used to describe the effect of ingredients like hulless barley, sugar, guar gum and ammonium bicarbonate. The model also explains the effect of ingredients on cookie characteristics. It was determined that

best quality, acceptable and optimized cookies could be produced by replacing up to 37.04% refined wheat flour by hull-less barley flour under investigated conditions when combined with other baking components such as sugar, guar gum and ammonium bicarbonate at levels 32.45, 3.23 and 3.14g/100g respectively. While treatment 17 showed superior sensory score in respect of quality over other treatments. It combined with refined wheat flour and hulless barley flour (75:15%), sugar (35%), guar gum (3.5%) and ammonium bi carbonate (3.5%).

References

1. Fastnaught CE, Berglund PT, Holm ET, Fox GJ. Genetic and environmental variation in β-glucan content and quality parameters of barley for food. Crop Science. 1996;36:941-946.
2. Florence Suma P, Urooj A, Asha MR, Rajiv J. Sensory, Physical and Nutritional Qualities of Cookies Prepared from Pearl Millet (Pennisetum Typhoideum). Journal Food Process Technology; c2014.
3. Hooda S, Jood S. Organoleptic and nutritional evaluation of wheat biscuits supplements with untreated and treated fenugreek flour. Food Chem. 2005;90:427-435.
4. Kumar D, Narwal S, Verma RPS, Kharab AS, Kumar V, Sharma I. Genotypic variability in β-glucan and crude protein contents in barley genotypes. J Wheat Res. 2012;4(2):61–68.
5. Kumar D, Verma RPS, Narwal S, Kharab AS, Malik R, Selvakumar R, *et al*. Barley lines with higher grain beta glucan content identified. Indian J Plant Genet Resour. 2015;28(3):346–347. doi: 10.5958/0976-1926.2015.00046.7.
6. Mayer's 1976 Mayer's Hypothesis: A Study of the Early Years of Thermodynamics, https://doi.org/10.1111/j.1600-0498.1976.tb00936.x
7. Narwal S, Kumar D, Verma RPS. Effect of genotype, environment and malting on the antioxidant activity and phenolic content of Indian barley. J Food Biochem. 2016;40:91-99. DOI: 10.1111/jfbc.12198.
8. Sabeeha Yaqoob, Waqas N Baba, Farooq Ahmad Masoodi, Rafiya Bazaz1, Musarat Shafi. Nutrafoods. 2017;16:175-183 DOI 10.1747/NF-017-1002-3.
9. Sharma P, Gujral HS. Antioxidant potential of wheat flour chapattis as affected by incorporating barley flour. LWT-Food Sci. Technol. 2014;56:118-123.
10. Wade P. Biscuits, Cookies and Crackers: Essex: Elsevier Applied Science Publishers Ltd., London, 1988, 1.
11. Waheed A, Rasool G, Asghar A. Effect of interesterified palm and cottonseed oil blends on cookie quality. Agric. Biol. J. N. Am. 2010;1(3):402-406.