Journal of Cereal Research
Volume 17 (3): 290-297
Homepage: http://epubs.icar.org.in/ejournal/index.php/JWR

Research Article

Utilisation of Durum Grains for Producing Wheat Grits for *Dalia* Preparation

Anuj Kumar, Manthn Sharma, Pooja Verma, Sunil Kumar, Vanita Pandey, Dinesh Kumar, OP Gupta, Vijay Singh, Charan Singh, Amit Kumar Sharma and Ratan Tiwari

ICAR-Indian Institute of Wheat and Barley Research, Karnal-132001, Haryana, India

Article history:
Received: 27 Nov., 2025
Revised: 15 Dec., 2025
Accepted: 17 Dec., 2025

Citation:
Kumar A, M Sharma, P Verma, S Kumar, V Pandey, D Kumar, OP Gupta, V Singh, C Singh, AK Sharma, R Tiwari. 2025. Utilisation of durum grains for producing wheat gritsfor *dalia* preparation. *Journal of Cereal Research* ***17 (3):*** *290-297. http://doi.org/10.25174/2582-2675/2025/173605*

****Corresponding author:***
E-mail: anuj19.ak@gmail.com

Abstract

Wheat grits are considered to be broken/ cut/ chopped/ cracked wheat pieces, which are consumed after cooking. In the present study, wheat grits obtained from three durum wheat varieties (DDW 47, DDW 48 and DDW 55) using a stone mill were evaluated for physicochemical and sensory attributes. The colour values in terms of Hunter colour attributes (L, a, b) for grits obtained varied from 59.7-62.8, 4.7-6.8, and 19.7-24.7, respectively. Further, the yellow pigment content of wheat grits varied from 5.53 to 6.65 ppm. Grits contained 9.12-10.4% protein and 1.33-1.43% mineral content. pH value of the grits varied from 6.35-6.39. Wheat grits manufacturing *via* milling also contributed towards the generation of by-product, containing about 10.98-11.01% protein, 2.13-2.42% ash content and 7.04-7.28 ppm yellow pigment, which has the potential to fulfil dietary needs *via* appropriate value addition. Further, the cooked sweetened milk-based *dalia* was liked by the sensory panellists, both as hot and cold desserts, with overall acceptability scores of 7.00-7.17 and 7.33-7.42, respectively. Durum-based wheat grits can be utilised as a mode to encourage value addition and product diversification.

Keywords: Durum, wheat grits, *dalia*, sensory attributes, cooking behaviour, yellow pigment

1. Introduction

The increased awareness among consumers of the link between food and well-being has reshaped the food landscape. Consumers are looking for foods with additional health benefits which can enhance overall wellness. The food industry is gravitating towards innovating healthier, minimally processed and clean foods. Wheat grits, which are considered to be cracked/broken/chopped/ cut wheat pieces, are obtained after cleaning, drying and cracking the whole wheat kernel appropriately. The grits are minimally processed grain products. These wheat grits are relished as a warm/ cold, sweet *dalia*, often prepared with milk and jaggery or sugar, or as a savoury dish, tempered with spices, vegetables, and herbs, akin to upma/ *khichdi* (https://www.indianhealthyrecipes.com/dalia-khichdi-recipe-dalia-recipe-baby/).

Wheat is grown on about 32.76 million hectares of land, producing 117.51 million tonnes of grain (3rd advance estimates, 2024-25; https://upag.gov.in/dash-reports/statewiseapy?rtab= Area%2C+Production+%26+Yield&rtype=reports). Durum wheat (*Triticum durum*) is a tetraploid hard wheat,and the durum grains are recognised for their amber-coloured kernels (high yellow pigment), high protein content, and hard texture. It contributes about 4% to the total wheat production of India and is mainly cultivated in Madhya Pradesh, Maharashtra, Gujarat, Karnataka, Southern Rajasthan and Bundelkhand in Uttar Pradesh (Singh, 2020). It is commonly used to produce semolina and pasta-like products. In parts of the country, it is also consumed as *rawa idly*, *upma* and *halwa* (Dhanavath and Prasada Rao, 2017).

Likewise, the yellowish colour of the durum grains should make these appealing to consumers in a minimally processed form, like *dalia*. However, its usage is very limited in producing wheat grits, which are essentially consumed as *dalia*, since the majority of wheat grits for *dalia* preparation are produced from *aestivum* wheat types. Manohar *et al*., (1998) utilized the medium hard wheat from the local market for producing wheat grits *via* milling. Similarly, Bhatt *et al*., (2022) and Raigar *et al*., (2017) also utilized *T. aestivum* for wheat grits preparation. Although, Jha *et al*., (2015) analyzed *dalia* premix production quality from PDW-233, WH-896, HD-2687, PBW-343 wheat varieties. The information on the production of wheat grits from recent durum wheat is scarce. Therefore, the present study was undertaken to prepare durum wheat grits from recent durum wheat varieties and to evaluate the physico chemical properties of grits and sensory attributes of *dalia* prepared therefrom.

2. Materials and Methods

Raw materials

The durum wheat varieties DDW 47, DDW 48 and DDW 55 were collected from the Karnal farm. The other ingredients required during the experimentation were procured from the local market. All the chemicals used during the analysis were of analytical grade and procured from the standard manufacturers.

Wheat grits preparation

The durum wheat grains were appropriately cleaned to remove dust, debris and other foreign items, and then dried to reduce the moisture content below ten per cent. The cleaned and dried grains were then milled using a small stone-based mill in a single pass for about five minutes. The yield of *dalia* samples was around 75%.The wheat grits, as well as the grit by-product,were collected, separated, packed in polyethene pouches, and stored in air-tight container at ambient temperature until analysis. Fig. 1 depicts the wheat grains of varieties along with wheat grits and the corresponding wheat grit by-product.

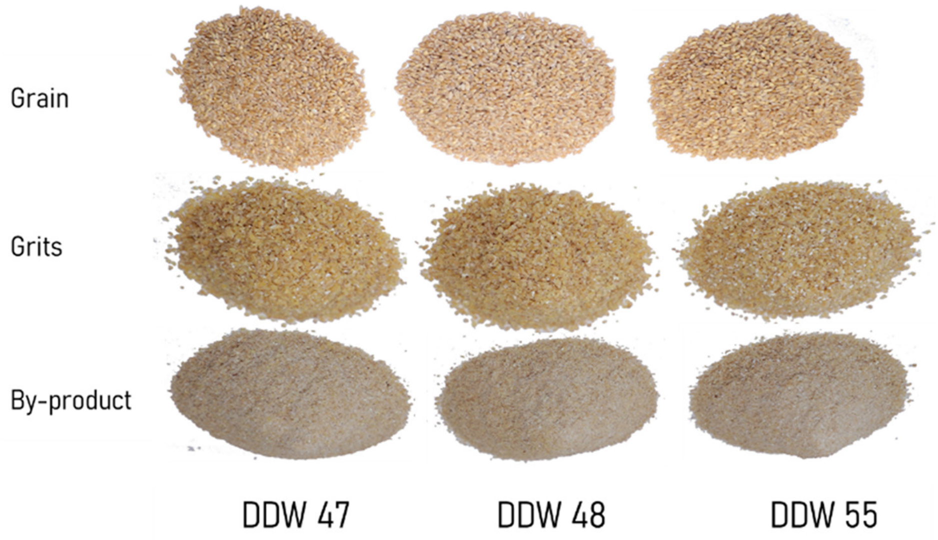

Fig. 1: Durum wheat grains along with their corresponding grits and by-product

Physicochemical attributes

The various physicochemical parameters were determined according to AOAC (2000). Briefly, the moisture content was determined gravimetrically using the hot-air drying method (105°C), and the ash content was determined after incinerating the sample in a muffle furnace(550°C). The total nitrogen was determined using the Kjel dahl protocol (Pelican Equipment, Chennai) and then multiplied by a factor of 5.81 to obtain protein content. The colour values were expressed in terms of Hunter L, a and b values (Hunter colorimeter). The pH content of the grits after grinding was measured directly (Nosa-Obanwonyi and Antai, 2019) using a pH meter (Eutech 700, Singapore). Yellow pigment was determined according to Ram *et al.* (2023).

Preparation of Dalia

Dalia samples were prepared in accordance with Mridula *et al.*, (2015) with minor modifications. The process flow for preparing *dalia* is depicted in Fig. 2. Briefly, wheat grits (50 g) were roasted in ghee (2.5 g) for about 5 minutes. Later, the *dalia* was allowed to cool to ambient temperature, then cooked in water and milk (200 ml each) for 20-25 min, and sweetened with sugar (10 g). The sensory evaluation was conducted for *dalia* as a hot and cold served dish. For cold serving, the *dalia* was chilled at 5°C overnight.

Sensory analysis

The sensory analysis of sweetened and cooked wheat grits (*dalia*) (Fig. 2) was performed using colour, taste, consistency and overall acceptability score as descriptors on a 9-point Hedonic rating scale. Hedonic scale sequence is as follows: Like extremely- 9, like very much- 8, like moderately- 7, like slightly- 6, neither like nor dislike- 5, dislike slightly- 4, dislike moderately- 3, dislike very much- 2, dislike extremely- 1.

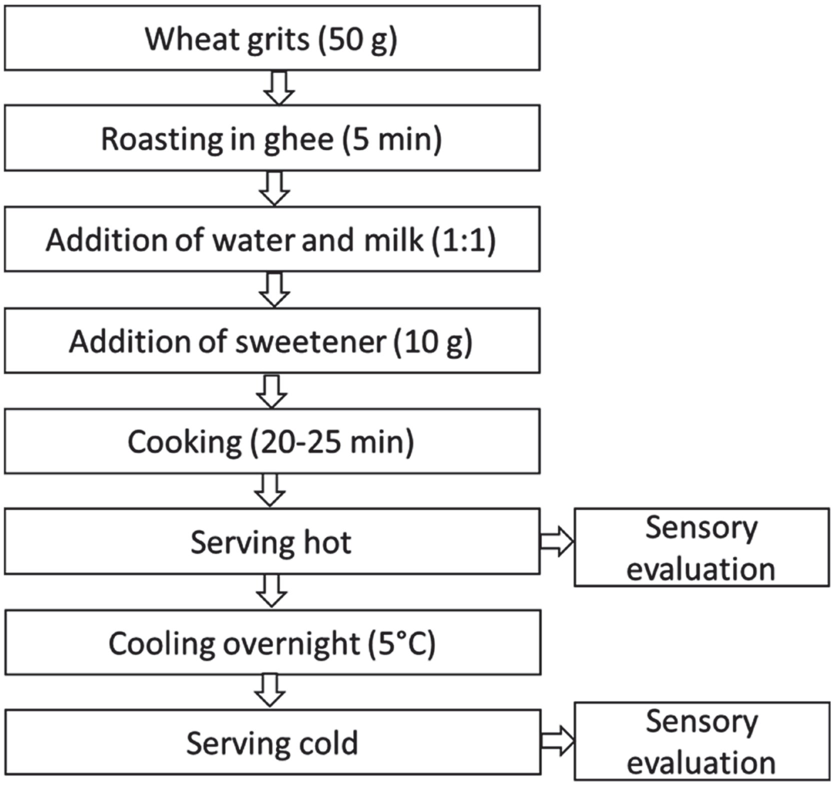

Fig. 2: Process flow describing the preparation of dalia sample for sensory evaluation

Cooking behaviour

The cooking properties *viz*, rehydration ratio and cook loss was determined by cooking in water. Rehydration ratio (RR) was determined according to Mridula *et al*., (2015) with minor modifications. Briefly, a ten-gram dalia sample was cooked in 250 ml of water for 20 min. The cooked grains were separated from the cooking medium using a hand-held sieve and tapping it continuously, allowing the cook water to drip. The rehydration ratio was calculated using the following model:

$$Rehydration\ ratio = \frac{Weight\ of\ cooked\ sample}{Weight\ of\ uncooked\ sample}$$

Further, the cook loss was determined in the cook water gravimetrically by drying the cook water in a hot-air oven at 105°C for 5 hours.

The analyses were conducted in duplicates. The results are expressed as mean and standard deviation.

3. Results and Discussion

Physicochemical attributes

The wheat grits from DDW 47, DDW 48 and DDW 55 were produced using a mill and analysed for moisture, protein and ash content. The moisture content of the wheat grits samples was less than 10% and ranged from 9.09% to 9.62%.The moisture content of grains ranged from 10% to 11% prior to conditioning for noodle making (Kaur *et al.*, 2015). A lower moisture content is expected to enhance the keeping quality of wheat grits. Lower moisture content in grain can be achieved by drying it for extended periods. It should be noted that drying at higher temperatures may affect gluten/ starch functionality (Kaushik *et al.*, 2014; Masato *et al.*, 2021) and may result in the loss of heat-sensitive nutrients.

The protein content of the wheat grit samples ranged from 9.12-10.14%. The mineral content determined as ash, varied from 1.33-1.43% (Fig. 3). The variability in the compositional attributes is narrow. Kaur *et al.*, (2015) observed wide variation in ash (0.6-1.2%) and protein content (11.66-15.13%) of durum wheat flour. Katyal *et al.*, (2018) observed protein content between 8.38 and 13.89% in Indian durum wheat accessions. Similarly, a wide variation has been reported in grain protein content (12% moisture basis) of various durum genotypes: 7.6-15.6% (ICAR-IIWBR, 2025). Further, El-Housini *et al.*, (2024) analysed the durum wheat landraces of the Moroccan region and reported these to contain 13.09% moisture, 2.23% ash content and 14.01% (db) protein content while Sayaslan *et al.*, (2012) noticed protein content ranging from 10.7-16.8 in selected Turkish durum landraces. It must be noted that the compositional attributes of the grain are governed by genotype, environmental factors, and the management practices followed during cultivation. Durum wheat varieties have higher protein content compared to the *aestivum* wheat types (Zilic *et al.*, 2010).

The pH value of the grits obtained was observed to be near neutral pH (6.35-6.39). Popovska *et al.*, (2023) observed the pH of whole wheat flour to be 6.71-6.75, while Dhillon *et al.*, (2020) reported the pH of whole wheat flour to be 6.81. Nosa-Obamwonyi and Antai (2019) reported pH of whole wheat meal samples to be 6.05 to 6.41 and pH of wheat semolina samples to be 6.02 to 6.34. Contrarily, Akoja *et al.*, (2018) noticed pH of wheat flour as 5.62. According to pH, wheat grits maybe categorised as a low-acid food. pH, along with acidity, governs the type of microbial growth in a food item upon spoilage. Very low and very high pH may prevent the growth of microorganisms (Mafe *et al.*, 2024). It also helps to understand and design the preservation process.

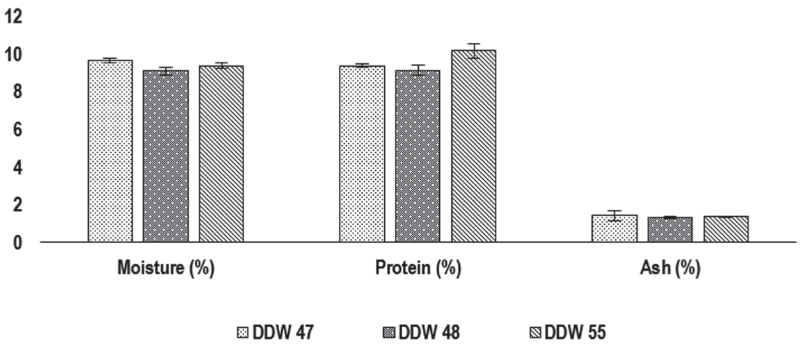

Fig. 3: Moisture, protein, and ash content for wheat grits prepared from durum wheat

The colour of wheat grits was expressed as Hunter *L*, *a*, and *b* values, wherein *L* value represents lightness/ darkness, *a* value represents redness/greenness, and *b* value represents yellowness/blueness. The Hunter *L, a* and *b* values of the wheat grits ranged from 59.7-62.8, 4.7-6.8 and 19.7-24.7, respectively (Fig. 4). Kaur *et al.*, (2015) observed Hunter L*, a* and b* values of durum wheat for different varieties varied from 56.42 to 58.47, 6.86 to 7.44, 18.13 to 19.11, respectively, while that of flour ranged from 90.92 to 92.25, 0.30 to 0.73 and 13.66 to 17.50, respectively.

The yellow pigment content from the durum wheat grits ranged from 5.53 to 6.65 ppm (Fig. 4). Kaur *et al.*, (2015) found yellow pigment levels ranging from 3.33 to 6.83 ppm in durum wheat varieties, while observed variation in Turkish durum landraces was 3.67 to 8.37 ppm (Sayaslan *et al.*, 2012). Similarly, variation in yellow pigment across durum wheat genotypes is quite considerable (3.3-9.6 ppm) (ICAR-IIWBR, 2025). Carotenoid pigments comprising lutein, zeaxanthin and β-cryptoxanthin constitute about 85% of the total carotenoids present in durum wheat and give the durum its characteristic yellow colour (Saini *et al*., 2023).The color of the durum wheat is its main USP. The durum wheat grains comprise various carotenoids consisting of lutein, β-carotene, zeaxanthin, β-cryptoxanthin, β-apocarotenal, antheraxanthin, taraxanthin (lutein-5,6-epoxide), flavoxanthin, and triticoxanthin. The α- and β-carotene (7.7%) are mainly located in the germ, while lutein, most abundant pigment (86–94%) is distributed across the layers. The lutein content in aleurone layer, starchy endosperm, and germ is 0.425, 0.557, and 2.157 mg/kg, respectively. Further, the aleurone layer and germ part contain 0.776 and 3.094 mg/kg zeaxanthin (Colasuonno *et al*., 2019).

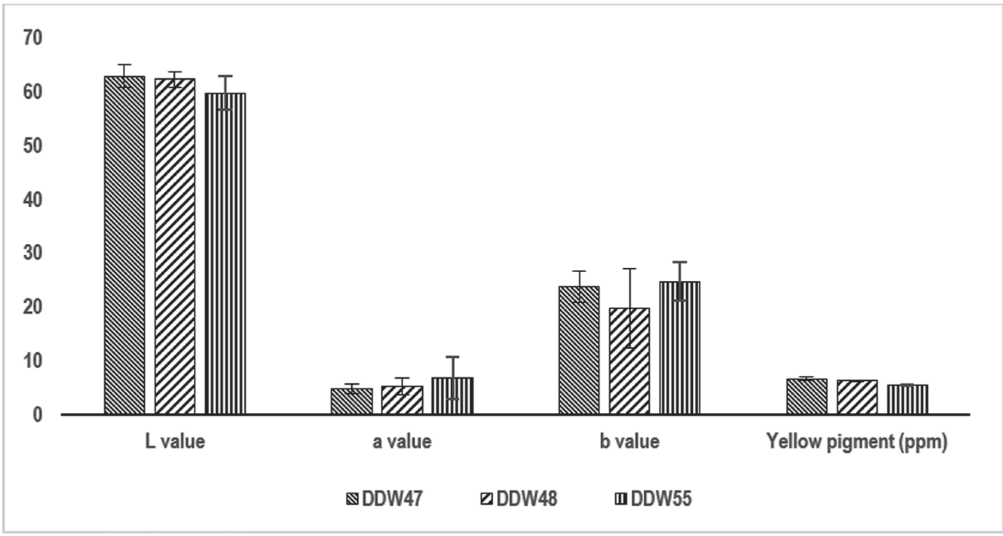

Fig. 4: Hunter color values (L, a, b) and yellow pigment content for wheat grits prepared from durum wheat

Cooking properties

The rehydration ratio signifies the water uptake during the cooking process (Mridula *et al*., 2015), and may imply the extent of gelatinization in the wheat grits. The rehydration ratio varied from 4.42 to 4.61,while the loss of solids in cooking water ranged from 1.35 to 1.48% (Table 1). Cook loss, defined as the loss of solids from the cooking water during cooking, depends on cooking time. A longer cooking time is expected to increase cooking loss by leaching of solids into the surrounding liquid. Further, cooking properties are also dependent upon the cellular structure, wherein it is expected that a disorganised cellular structure offers enhanced opportunity for water uptake during cooking (Singh and Singh, 2010). The protein content, starch type and amount, and starch-protein interactions might also play an important role in determining cook loss and needs to be explored. Further, the loss of solids is expected to alter the viscosity of the cooking medium. Cooking behaviour is also impacted by the grit shape, size and proportion of different grits in the sample.

Table 1: Rehydration ratio and cook loss of wheat grits

Variety	Rehydration ratio	Cook loss (%)
DDW 47	4.42±0.04	1.41±0.01
DDW 48	4.60±0.12	1.48±0.03
DDW 55	4.61±0.02	1.35±0.15

Sensory analysis for cooked wheat grits

Sensory analysis of a food helps in assessing the product's attributes like colour, flavour and texture *via* human senses to determine the quality, acceptability, and consumer preference of the food item. Sensory analysis of sweetened cooked *dalia* was conducted while serving it hot and cold. The scores are displayed using radar chart (Fig. 5 and Fig. 6). The sensory overall acceptability scores for *dalia* in hot and cold serve conditions varied from 7.00 to 7.17 and 7.33 to 7.42, respectively, on a 9-point Hedonic scale. The sensory colour, taste, and consistency scores for the cooked wheat grits samples, while served hot, varied from 7.25-7.25, 7.00-7.08, and 7.08-7.17, respectively, while the sensory colour, taste, and consistency scores of cooked *dalia* samples, when served cold ranged from 7.25-7.33, 7.25-7.42 and 7.25-7.42, respectively. As observed the scores for all sensory descriptors lay in 'like moderately' to 'like very much' range.

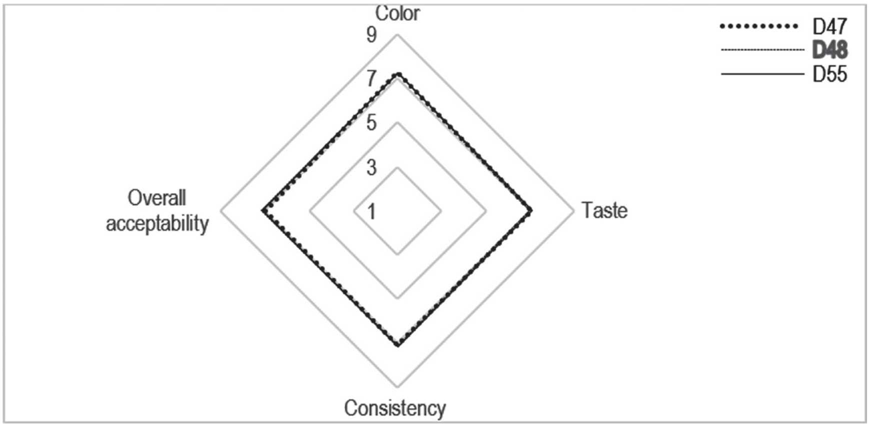

Fig. 5: Sensory scores for *dalia* as a hot dessert prepared from durum varieties

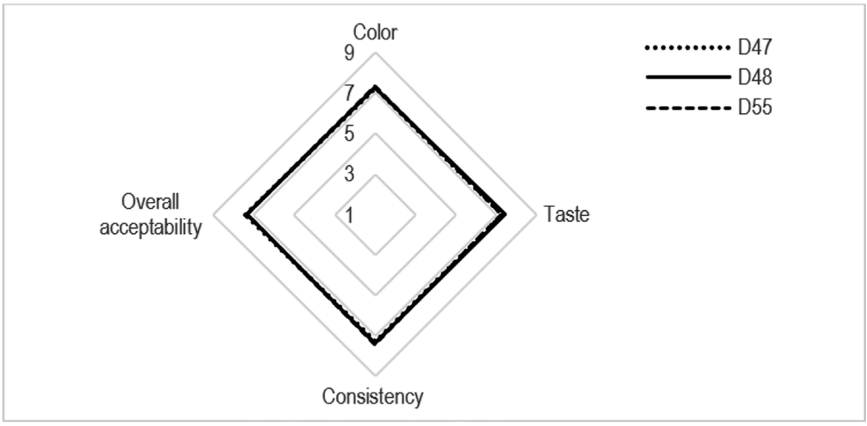

Fig. 6: Sensory scores for *dalia* as a cold dessert prepared from durum varieties

Compositional attributes of dalia by-product

As described earlier, wheat grits, the end product, are obtained after milling wheat grains. During milling to obtain wheat grits, by-product was generated, which was similar to coarsely ground flour (bran) in appearance. It is also observed that the by-product contains a significant amount of protein, minerals (ash content) and yellow pigment. The dry matter content in the *dalia* by-product ranged from 90.4% to 90.9%. The protein and mineral (ash) content ranged from 10.98% to 11.07% and from 2.13% to 2.42%, respectively. Similarly, the yellow pigment varied from 7.04 ppm to 7.28 ppm (Fig. 7).

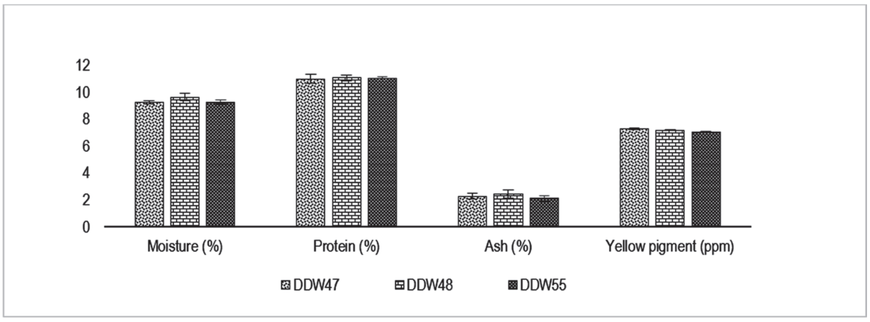

Fig. 7. Protein, ash and yellow pigment levels in wheat grit by product

The amount of milling by-product generated could have depended on the characteristics of the grain. Further, it may vary with milling type and milling parameters, *e.g.,* milling speed, which may affect the partitioning of nutrients going into wheat grits (*dalia*) and grit by-product. Further, the distribution of nutrients in wheat grains may also impact the nutrient profile of wheat grits as well as by-product. The higher protein and mineral content of the by-product might be due to the presence of higher levels of bran in comparison to endosperm. The ash content in bran has been found to be 3.39 g/100g (Stevenson *et al*., 2012) and is comparatively higher than the whole grain (1.12 g/100g). The by-product offers an opportunity for value addition.

4. Conclusion

Wheat grits prepared from durum varieties reflected a rehydration ratio of 4.41-4.62 and a solid loss of 1.35 to 1.48%. Durum wheat grits were accepted sensorily, as evidenced by a sensory score of more than 7.0; however, the preference was more for the cold-served product. *Dalia* preparation appeared to be a unique attempt at product diversification and value addition for durum wheat in a convenient, minimally processed form. This aligns with the current trend in consumer demand for traditional and healthy foods. The *dalia* can be promoted to health-conscious consumers seeking clean-label products. Further research may be carried out to develop instant *dalia* mixes from durum wheat by standardising processing parameters such as cooking properties, particle size, starch behaviour, and drying properties. The inclusion of dehydrated vegetables, pulses, and other ingredients may also be explored to enhance the nutritional potential. The milling appeared to be contributing to changes in the compositional aspects of the wheat grits. There exists a need to explore the milling behaviour of the wheat grits. Further, the stone milling technique could be suitably modified to enhance the yield and nutritional content of the wheat grits, and consequently minimise the by-product yield.

Acknowledgement

The authors are grateful to ICAR for funding the research.

Author Contributions

AK planned the experiment, prepared and edited the manuscript; MS, PV, VS, CS, AS provided all technical assistance; VP, SK, OPG, DK planned and edited; RT: Planning and guidance. All authors read, edited, and approved the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Approval

The article doesn't contain any study involving ethical approval.

Use of Generative AI or AI assisted technologies

Authors declare that no Generative AI or AI assisted technologies have been used in preparation of this manuscript.

References

1. Akoja SS and OJ Coker. 2018. Physicochemical, functional, pasting and sensory properties of wheat flour biscuit incorporated with okra powder. *International Journal of Food Science and Nutrition*, ***3***(5), 64-70.
2. Bhatt Y, and AS Jyothi Lakshmi. 2022. Effect of processing treatments on digestibility and physicochemical properties of ready-to-cook breakfast mixes. *Journal of Food Processing and Preservation*, ***46***(3), e16324.
3. Colasuonno P, I Marcotuli, A Blanco, M Maccaferri, GE Condorelli, R Tuberosa, R Parada, Ac de Camargo, AR Schewmber andA Gadaleta. 2019. Carotenoid pigment content in durum wheat (*Triticum turgidum* L. var durum): An overview of quantitative trait loci and candidate genes. Frontiers in plant science, 10, 1347.
4. Dhanavath S and UJS Prasada Rao. 2017. Nutritional and nutraceutical properties of *Triticum dicoccum* wheat and its health benefits: an overview. *Journal of Food Science*, ***82***(10), 2243-2250.
5. Dhillon B, G Choudhary and NS Sodhi. 2020. A study on physicochemical, antioxidant and microbial properties of germinated wheat flour and its utilisation in breads. *Journal of Food Science and Technology*, ***57***(8), 2800-2808.
6. El Houssni I, A Zahidi, K Khedid, and R Hassikou. 2024. Nutrient and anti-nutrient composition of durum, soft and red wheat landraces: Implications for nutrition and mineral bioavailability. *Journal of Agriculture and Food Research*, ***15***, 101078.
7. ICAR-IIWBR. 2025. Progress report of All India Coordinated Research Project on Wheat and Barley 2024-25, Wheat Quality. Eds: Sunil Kumar, Dinesh Kumar, O.P. Gupta, Anuj Kumar, Vanita Pandey

and Ratan Tiwari. ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana, India. p. 204

8. Jha A, BN Shalini, AA Patel, M Singh, and P Rasane. 2015. Optimisation of instant *dalia* dessert pre-mix production by using response surface methodology. *Journal* of *Food Science* and *Technology*, ***52***(2), 920-927.

9. Katyal M, AS Virdi, N Singh, A Kaur, JC Rana and J Kumari. 2018. Diversity in protein profiling, pasting, empirical and dynamic dough rheological properties of meal from different durum wheat accessions. *Journal of Food Science and Technology*, ***55***(4), 1256-1269.

10. Kaur A, N Singh, S Kaur, M Katyal, AS Virdi, D Kaur, AK Ahalawat and AM Singh. 2015. Relationship of various flour properties with noodle-making characteristics among durum wheat varieties. *Food Chemistry*, ***188***, 517-526.

11. Kaushik R, N Kumar, MK Sihag, A Ray. 2015. Isolation, characterization of wheat gluten and its regeneration properties. *Journal of Food Science and Technology*, ***52***(9), 5930-5937.

12. Mafe AN, GIEdo, RSMakia, OA Joshua, PO Akpoghelie, TS Gaaz, AN Jikah, E Yousif, EF Isoje, UA Igbuku, DS Ahmed, AEA Essaghah and H Umar. 2024. A review on food spoilage mechanisms, food borne diseases and commercial aspects of food preservation and processing. *Food Chemistry Advances*, **5**, 100852.

13. Manohar RS, B Manohar, and PH Rao. 1998. Rheological Characterization of Wheat Porridge (cooked dalia), a Semi-liquid Breakfast Food. *Journal of Cereal Science*, **27**(1), 103-108.

14. Masato O, M Kentaro, M Tatsuro, F Akio, H Yukako and M Yasuki. 2021. Effects of drying temperature on the properties of starch in pasta. *LWT*, ***145***, 111171.

15. Mridula D, M Sharma and RK Gupta. 2015. Development of quick cooking multi-grain *dalia* utilising sprouted grains. *Journal of Food Science and Technology*, ***52***(9), 5826-5833.

16. Nosa-Obamwonyi JA and SP Antai. 2019. Physicochemical properties and mycological quality of wheat flours consumed in Calabar, Nigeria. *Asian Food Science Journal*, ***6***(1):1-9.

17. Popovska O. 2023. Determination of some flour characteristics. *European Journal of Agriculture and Food Sciences*, ***5***(4), 8-12.

18. Raigar RK, PK Prabhakar, and PP Srivastav. 2017. Effect of different thermal treatments on grinding characteristics, granular morphology and yield of ready-to-eat wheat grits. *Journal of Food Process Engineering*, ***40***(2), e12363.

19. Ram S, S Kumar, OP Gupta, V Pandey, A Kumar, S Jaswal, V Singh and G Singh. 2023. Laboratory manual on protocols for evaluation of wheat quality, ICAR-Indian Institute of Wheat & Barley Research, Karnal 132001, pp-36.

20. Saini P, H Kaur, V Tyagi, P Saini, N Ahmed, HS Dhaliwal and I Sheikh. 2023. Nutritional value and end-use quality of durum wheat. *Cereal Research Communications*, *51*(2), 283-294.

21. Sayaslan A, M Koyuncu, A Yildirim, T Güleç, O Sönmezoğlu, and N Kandemir. 2012. Some quality characteristics of selected durum wheat (*Triticum durum*) landraces. *Turkish Journal of Agriculture and Forestry*, ***36***(6), 749-756.

22. Singh S and N Singh. 2010. Effect of debranning on the physico-chemical, cooking, pasting and textural properties of common and durum wheat varieties. *Food Research International*, ***43***(9), 2277-2283.

23. Singh V. 2020. Durum wheat scenario in India. Directorate of Wheat Development (pp. 64), Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers Welfare, Government of India.

24. Stevenson LEO, F Phillips, K O'Sullivan, and J Walton. 2012. Wheat bran: its composition and benefits to health, a European perspective. *International Journal of Food Sciences and Nutrition*, ***63***(8), 1001-1013.

25. Zilic SA, D Dodig, VHT Sukalovic, M Maksimovic, G Saratlic, and B Skrbic. 2010. Bread and durum wheat compared for antioxidants contents, and lipoxygenase and peroxidase activities. *International Journal of Food Science and Technology*, ***45***(7), 1360-1367.