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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(2): 613-616

www.thepharmajournal.com
Received: 14-11-2022
Accepted: 18-12-2022

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# Studies on isolation and utilization of sorghum starch

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**Abstract**
The present research work on "Studies on isolation and utilization of sorghum starch" was undertaken to explore the underutilized or neglected but highly nutrient rich sorghum starch value added products. The sorghum starch is a rich source of protein, crude fiber, carbohydrate was utilized products such as kurdai. Sorghum is good source of protein, crude fibre and carbohydrate. The prepared kurdai was analyzed for nutritional composition. The changes occurred during storage of kurdai was also studied.
Sorghum contained moisture 7.79%, fat 2.93%, carbohydrate 66.12%, protein 12.01%, crude fibre 3.32%, calcium 15.07 mg/100 g and iron 4.23 mg/100 g. Physical properties of soghum were creamy white and pearly white in colour and bulk density 706.28 Kg/cm3. Porosity of sorghum grain is 36.31%.
The result obtained showed that good quality kurdai can be prepared by using starch of sorghum variety Phule Yashomati. kurdai were packed in low density polyethylene (LDPE) stored for 90 days at ambient temperature (30±40C) to evaluate their storage feasibility.
Chemical composition of kurdai showed moisture content 4.32 percent, protein content 1.74 percent, fat content 1.42 percent, crude fibre 0.74 percent, carbohydrates 94.45 percent, calcium 13.42 mg/100 g and iron 3.58 mg/100 g. During 90 days of storage period the sensory evaluation of kurdai was done regularly at an interval of 30 days. The overall acceptability score for Phule Yashomati was decreased from 8.53 to 7.98 in LDPE with increased in storage period. Overall acceptability score was highest for Phule Yashomati kurdai.

**Keywords:** Kurdai, starch, Isolation, jowar, utilization

## Introduction
Sorghum (*Sorghum bicolor* (L.) Moench), is also called as *jowar* is belongs to the Graminae family and has a diploid chromosomal number of 2n = 20. Sorghum, the king of cereals, is a crucial food crop in dry regions of China and India (Shobha *et al*., 2008) [9]. Sorghum ranks as the fifth-most significant cereal in the world after wheat, rice, maize, and barley (Anglani, 1998; Awika and Rooney, 2004) [2, 3]. Both maize (*Zea mays*) and sorghum (*Sorghum bicolor* L. Moench) are members of the Panicoideae subfamily of the Gramineae family. Grass species include *Sorghum bicolor* and *Sorghum vulgare*. India is the world's second-largest producer of sorghum and tops the list for many other commodities like millets and grains. The main source of staple food in of Maharashtra, and it is also an important food of Tamil Nadu, Andhra Pradesh, and Madhya Pradesh.
Non-glutinous flours, which are present in sorghum, help to protect the gastrointestinal tract from harm and to make it easier for nutrients to be absorbed. Patients with celiac disease must consume a gluten-free diet, thus sorghum flour is ideal for both baking and cooking. As a result, sorghum has the potential to replace wheat in the industrialised world for people who have celiac disease or gluten intolerance (Bogue and Sorenson, 2008) [11]. Sorghum protein exceeds wheat protein in terms of digestive accessibility and biological usefulness. The risk of cardiovascular disease is also reduced. Women with polycystic ovarian syndrome may benefit from a sorghum diet. Grain giant millet contains phenolic compounds and flavonoids (Shahidi and Naczk, 1995) [8]. Additionally, it has anti-oxidants that decrease cholesterol and prevent cancer.

## Materials Raw Materials
The grains of five sorghum varieties *viz*., Phule Suchitra, Phule Revati, Phule Yashomati, Phule Vasudha, and RSV 2371 for the present study were obtained from the all India Co-ordinated Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri.

**Packaging material**

The packaging material *viz*., LDPE bags were procured from local market and used for packaging of kurdai for storage study.

**Procedure of isolation of starch from sorghum**

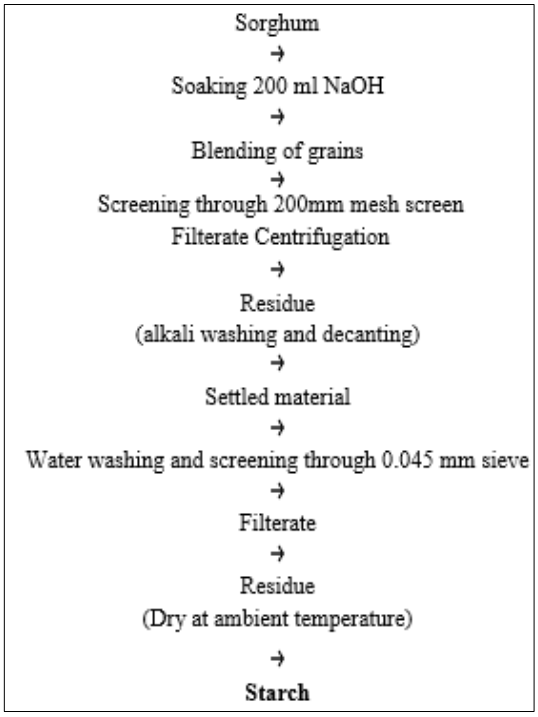


**Fig 1:** Flow chart for isolation of starch from sorghum

**Procedure of kurdai**

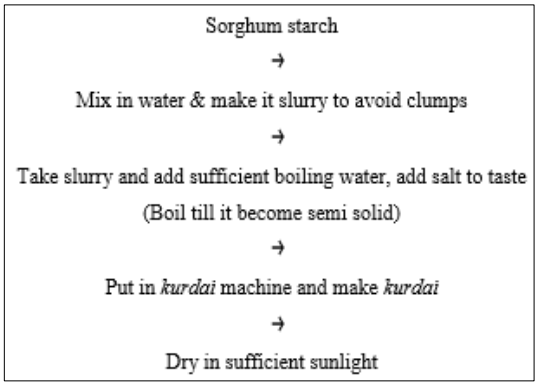


**Fig 2:** Flow chart for preparation of kurdai from sorghum starch

**Chemical analysis of kurdai**

The chemical analysis of kurdai was performed for different parameters as described in Table 2. The kurdai was ground to powder form in moisture free environment before analysis for interval of 30 days (90 days). Average value of three determinations was reported.

**Sensory / organoleptic evaluation of kurdai**

The sensory / organoleptic evaluation of kurdai was carried out using the standard technique for colour and appearance, flavour, texture, taste and overall acceptability Amerine *et al*. (1980) [1]. Semi-trained judges were used and the quality of the sorghum kurdai was rated on a 1 to 9point hedonic scale. The quality was assessed using the average of 10 judges. The best treatment was chosen for future research based on sensory score card evaluation. The impact of changes in product quality during storage on sensory metrics of sorghum kurdai was also investigated.

**Storage Studies of kurdai**

**Storage condition**

The kurdai was packaged in LDPE and kept at room temperature for 90 days. After interval of 0, 30, 60, and 90 days, all samples were taken and analysed for sensory characteristics using the technique outlined previously in this chapter. At 0 and 90 days, the microbiological quality was assessed.

**Result and Discussion**

**Physical parameters of sorghum grain**

Table 1 shows the physical characteristics of sorghum. The results showed that the sorghum grain is white in colour. The seeds of the RSV 2371 variety are white in colour, while the seeds of other types are pearly white and creamy white coloured. 4 cultivars have porosity values ranging from 34.80 to 37.43%, with RSV 2371 having the highest percent at 37.43%. The bulk density of varieties varies between 630.42 and 773.58 kg/m3, whereas true density varies between 987.24 and 1251.47 kg/ m3 (Singh *et al*., 2010) [10]. This results are comparable to those obtained by Jambamma (2011) [6].

**Table 1:** Physical parameters of sorghum grain

| Varieties | 1000 kernel wt. (g) | Colour | True density (kg/m3) | Bulk density (kg/m3) | Porosity (%) |
|---|---|---|---|---|---|
| Phule Revati | 36.50 | Pearly White | 1144.76 | 732.51 | 35.87 |
| Phule Yashomati | 33.58 | Pearly White | 1083.27 | 704.51 | 36.48 |
| Phule Vasudha | 35.40 | Creamy White | 1127.85 | 718.29 | 36.23 |
| Phule Suchitra | 36.58 | Creamy White | 1176.53 | 745.68 | 35.58 |
| RSV 2371 | 28.92 | White | 987.24 | 630.42 | 37.43 |
| Mean | 34.19 | - | 1103.93 | 706.28 | 36.31 |

All results are mean of three replications.

**Chemical composition of sorghum**

**Table 2:** Chemical composition of sorghum

| Varieties | Moisture (%) | Protein (%) | Fat (%) | Crude fibre (%) | Starch (%) | Calcium (mg/100 g) | Iron (mg/100 g) |
|---|---|---|---|---|---|---|---|
| Phule Revati | 8.01 | 12.70 | 2.20 | 2.81 | 68.12 | 15.59 | 4.68 |
| Phule Yashomati | 7.72 | 12.68 | 3.21 | 3.24 | 69.09 | 14.59 | 4.15 |
| Phule Vasudha | 7.46 | 12.20 | 2.69 | 2.77 | 64.61 | 14.82 | 3.82 |
| Phule Suchitra | 7.39 | 10.51 | 3.54 | 3.95 | 66.41 | 15.72 | 4.42 |
| RSV 2371 | 8.39 | 11.98 | 3.01 | 3.83 | 62.40 | 14.67 | 4.08 |
| Mean | 7.79 | 12.01 | 2.93 | 3.32 | 66.12 | 15.07 | 4.23 |

All results are mean of three replications.

The moisture level of the varieties ranged from 7.39% to 8.39%, with the Phule Suchitra having the lowest value and RSV 2371 having the highest. The fat level of the sorghum grains ranged from 2.20% to 3.01%, with the Phule Revati having the lowest fat content and Phule Suchitra having the greatest fat content. The protein content of varieties ranged from 10.51% to 12.70%, with the Phule Suchitra type having the lowest value and Phule Revati having the highest.

The crude fibre content of the samples ranged from 2.81% to 3.95%, with the lowest values in Phule Revati and the highest in the Phule Suchitra type. The total carbohydrates content ranged from 62.40% to 69.09%, with the lowest value being found in RSV 2371 and the highest in the Phule Yashomati. The calcium concentration of the samples ranged from 14.59 mg/100 g to 15.72 mg/100 g, with Phule Yashomati containing the lowest value and Phule Suchitra containing the highest. The iron level of the samples ranged from 3.82 mg/100 g to 4.68 mg/100 g, with Phule Vasudha having the lowest value and Phule Revati having the highest. This results are comparable to those evaluated by Chavan *et al*. (2016) [5] and Patekar *et al*. (2017) [7].

**Physical parameters of sorghum starch kurdai and wheat kurdai**

The best variety for kurdai preparation were selected on the basis of organoleptic 9 point hedonic scale using minimum 10 semi-trained judges and same treatment was utilised for preparation of kurdai from different sorghum genotypes to find out best genotype for kurdai preparation. Each variety's raw material weight is up to 500 g for kurdai preparation. After frying, different weights are achieved for each species. Phule Samadhan has the highest weight of kurdai, followed by Phule Suchitra, with 458.12 g and 445.60 g respectively. The diameter of the kurdai is measured using a vernier calliper and the largest diameter is 3.9 mm for the control as well as for Phule Samadhan cultivar of wheat and the average of the six cultivar is up to 3.68 mm. In terms of texture, the sorghum variants had a higher hardness value than control, and control required more crushing force than sorghum variety kurdai. It signifies that compressing a little piece of sorghum kurdai sample demands greater force than breaking a huge quantity of the same control sample. As a result, the sorghum kurdai became crispier and more crunchy. This type of characteristic is excellent from the standpoint of the consumer.

**Table 3:** Physical parameters of sorghum starch kurdai and wheat kurdai

| Variety | Weight (g) | Diameter (mm) | Texture analysis | |
|---|---|---|---|---|
| | | | Hardness(N) | Crushing(N) |
| Phule Samadhan | 458.12 | 3.9 | 6.13 | 2.78 |
| Phule Revati | 442.25 | 3.7 | 6.76 | 2.34 |
| Phule Yashomati | 438.35 | 3.8 | 6.36 | 2.66 |
| Phule Vasudha | 439.45 | 3.7 | 7.55 | 2.12 |
| Phule Suchitra | 448.39 | 3.6 | 7.44 | 2.16 |
| RSV 237 | 435.80 | 3.4 | 7.12 | 2.44 |
| Mean | 446.54 | 3.68 | 6.96 | 2.41 |

All results are mean of three replications.

**Table 4:** Chemical Composition of Sorghum kurdai and Wheat Kurdai

| Variety | Moisture (%) | Protein (%) | Fat (%) | Crude fibre (%) | Carbohydrate (%) | Calcium (mg/100 g) | Iron(m g/100 g) |
|---|---|---|---|---|---|---|---|
| Phule Samadhan | 4.33 | 1.97 | 1.59 | 0.70 | 95.30 | 13.73 | 3.50 |
| Phule Revati | 4.38 | 1.73 | 1.49 | 0.64 | 94.48 | 12.98 | 3.68 |
| Phule Yashomati | 4.29 | 1.88 | 1.38 | 0.60 | 94.80 | 14.08 | 4.23 |
| Phulem Vasudha | 4.13 | 1.68 | 1.23 | 0.84 | 93.20 | 13.46 | 3.12 |
| Phule Suchitra | 4.39 | 1.51 | 1.48 | 0.78 | 92.10 | 12.96 | 3.75 |
| RSV 2371 | 4.41 | 1.72 | 1.57 | 0.77 | 94.22 | 14.08 | 3.78 |
| Mean | 4.32 | 1.74 | 1.42 | 0.74 | 94.45 | 13.42 | 3.58 |

All results are mean of three replications.

Table 4 shows the nutritional value of Sorghum kurdai and Wheat kurdai. When compared to other types, the moisture content was better under control, at 4.41%, with the lowest moisture content being 4.13% in the Phule Vasudha Variety. When compared to the variety, the fat level of RSV 2371 (1.57%) was higher, while it was lowest in Phule Vasudha (1.23%). This means the oil absorption was more in RSV 2371 kurdai. The RSV 2371 kurdai had a higher protein level is 1.88%. It accounts for 1.72% in the RSV 2371 kurdai and 1.97% in control kurdai.

Utilization of immature banana powder in developed kurdai by K. G. Chavan *et al*. (2018) [4] yielded similar findings. The current findings are comparable to or in line with those found in the literature.

**Conclusion**

The present investigation showed that the kurdai prepared from sorghum variety Phule Yashomati had better acceptability as compared to other varieties. kurdai can be kept for up to 90 days in LDPE packaging material in good condition. Both the control as well as kurdai prepared from different varieties of sorghum showed good physical, chemical, and sensory properties. It is concluded from all the physical, chemical properties, sensory quality that Phule Yashomati of MPKV, Rahuri are best suited for kurdai preparation. The cost of production of kurdai was less than that of market values of the products, hence such value-added products have the potential to improve economic conditions and human health while requiring minimum investment.

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