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Physico-Chemical Variation Ontikhur Powder Extracted By Laboratory Grinder and Extraction Machine

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A B S T R A C T

The starch obtained from the *tikhur* rhizomes is highly nutritious and easily digestible. In this paper describe the variation of physicochemical properties on *tikhur* powder extracted from rhizome by two different methods such as laboratory grinder and starch extraction machine. Results shows that the values of physicochemical properties slightly differ in protein and ash but no more significant variation finds. The data of water solubility index and swelling powers of *tikhur* powder was increased with increasing temperature range from50–100°C. In concussion the use of both methods for powder extraction are more useful and economical.

Introduction

Tikhur (*Curcuma angustifolia* Roxb.) is an important annual herb belongs to the family of *Zingiberaceae*, which also contain plants such as ginger and turmeric (Sashikumar, 2007). This species is native to the Indian subcontinent and is more commonly known as East Indian Arrowroot or Narrow leaved turmeric in English, and is called "yaipan" in Manipuri, "*tikhur*" in Hindi, and "Koova" in Malayalam, Tavaksira in Sanskrit, Tavakila in Marathi, Ararut-kizhagu in Tamil, Keturi Halodhi in Bengali (Patel *et al.*, 2015).

The plant is most commonly found growing wild in Indian especially in the North East and Western coastal plains and hills. Such areas include the states of Maharashtra, Madhya Pradesh, Andhra Pradesh, Himanchal Pradesh, Chhattisgarh, Bihar, Jharkhand, West Bengal, Tamil Nadu and Kerala (Tiwari and Patel, 2013). This species can also be found in Burma, Laos, Nepal and Pakistan (Ravindran *et al.*, 2007). Its major availability is reported in moist deciduous Sal and mixed forest of Madhya Pradesh, Chhattisgarh and Jharkhand (Tiwari and Patel, 2013). At the present time the collection of *tikhur* rhizomes and its traditional and mechanical processing for the extraction of starch is generally done by the tribal farm families residing in and around the forest areas of these regions.

Tikhur rhizome is highly valued as an article of diet. The starch obtained from the dry powdered rhizome forms the chief source of the plant and starch obtained from the rhizomes is highly nutritious and easily digestible, therefore, it is recommended for infants, weak children and invalids. Starch recovery is 12.5% from the tuber, is in high demand (Wealth of India, 1972). The starch can be consumed by individuals during fast as it is rich in energy. The starch of *tikhur* is used for the preparation of many sweet meals and herbal dishes like *halwa, barfi, jalebi etc.* It is used specially during fast (*Vrata, Upwas*). Farmers also prepare herbal drink "*sarbat*" through *tikhur* starch during summer due to its cooling effect (Singh and Palta, 2004).

The present investigation carried out to study the "Physicochemical Variation on *tikhur* Powder Extracted by Laboratory Grinder and Starch Extraction Machine" was conducted at SV College of Agricultural Engineering and Technology, Raipur, Chhattisgarh.

Materials and Methods

The study was conducted at SV College of Agricultural Engineering and Technology, Raipur in Agricultural Processing and Food Engineering laboratory during 2016-17. *tikhur* rhizome was procured from the local market of Dhamtari District of Chhattisgarh and two methods (Laboratory grinder and starch extraction machine) was used for extraction of powder from the *tikhur* rhizomes (Fig. 1). The analysis of various physicochemical properties such as moisture content, bulk and true density, water solubility index, swelling power, ash content, fat percent, fiber, protein content, carbohydrate and titrable acidity of extracted powder was done in the R.H. Richharia Research Laboratory of the IGKV by using standard techniques.

Physicochemical properties of *tikhur* powder

The moisture content was determined by using moisture analyzer (Fig. 2). About five gram (5 g) of sample was kept in the moisture analyzer at 180°C. The method was continued till the entire moisture was evaporated.

Bulk density and true density

Bulk density was determined by filling a measuring cylinder of 100 ml with *tikhur powder* by pouring it form a certain height, striking off the top level and weighing the contents on a balance. The ratio of weight of the sample and volume occupied by it is expresses as the bulk density. Bulk density of the powder was expressed in g/ ml was determined using equation (1):

$$Db = \frac{M}{V_0} \qquad (1)$$

Where,

D_b, M and V_0 are bulk density in g/ml, mass of powder in g and bulk volume of powder in ml, respectively

True density was determined by adding 5 g of starch powder in 25 ml toluene in 100 ml measuring cylinder. The final volume was noted and true volume of starch powder sample was determined from the difference. The true density of the sample was expressed as the ratio of weight of sample and the true volume. True density was calculated using equation (2):

$$\text{True density}\left(\frac{g}{ml}\right) = \frac{\text{Weight of sample(g)}}{\text{True volume(ml)}} \qquad (2)$$

Ash content

Ash content was determined according to AOAC (1995) procedure. 2g of sample was taken in a silica crucible and weighed. It was made to ash in a muffle furnace at 600°C for 3 to 4 hours. The crucible was cooled in the desiccators and weighed, and the value for ash content was calculated by using the following expression (3):

$$\mathit{Ashcontent}, \% = \frac{\text{Weight of ash} + \text{crusible} - \text{Weight of crusible}}{\text{Initial weight of sample}} \times 100 \qquad (3)$$

Fat content

The total fat content was calculated by the Soxhlet method as described in the AOAC (1995) method. In this technique 2 g of sample was taken into the thimble. With the help of anhydrous ether (boiling point 60 – 80˚C) and "*Socs Plus*" (extraction equipment) fat was extracted. The amount of fat was calculated by the following formula (4):

$$\text{Fat content}, \% = \frac{B - A}{W} \times 100 \qquad (4)$$

Where;
A, B and Ware initial weight of beaker, final weight of beaker andweight of sample in g

Dietary fiber

The total dietary fiber, a measure of the sum of insoluble and soluble dietary fiber, based on digestion of food samples (1g) which was taken into the crucibles was analysed using fibre plus system (Pelican make) with standard method.

$$\text{Fiber}, \% = \frac{\text{Weight of crusible plus fiber} - \text{Weight of empty crusible}}{\text{Initial weight of sample}} \times 100 \qquad (5)$$

Protein

Protein of the *tikhur* powder was determined by Kjeldahl method (Jackson, 1958) by digesting 0.3 g of powder sample in 10 ml conc. H_2SO_4 and catalyst mixture of potassium sulphate and copper sulphate in 5:1 ratio followed by distillation and titration. The obtained value of nitrogen was multiplied with the factor 6.25 to get powder protein per cent.

The amount of protein was calculated by following formula (6):

$$\text{Nitrogen} = \frac{14.01 \times 0.1\,N \times (TV - BV) \times 100}{W \times 1000} \qquad (6)$$

$$\text{Protein }\% = \%\text{ Nitrogen} \times 6.25 \quad \text{(for Food samples)}$$

Where,

14.01 = Ammonia's molecular weight
0.1 N = Titration solution's normality
TV and BV = Titer value and blank value

Total carbohydrate

The total carbohydrates were calculated by the by AOAC (1995) method. After determining the percentage of moisture, protein, and fat and total ash content in the developed sample it was calculated as follows (7):

Total carbohydrate, % = {100 – (A+B+C+D)} % (7)

Where,
A, B, C and D are moisture content, protein, fat and ash content in per cent, respectively

pH value

One gram (1g) of the individual starch was added to 100 ml of distilled water and the pH was determined in an electronic pH meter.

Titrable acidity

The titrable acidity of *tikhur* powder was determined as per the procedure of Ranganna (1997). The powder (10 g) was diluted with 200 ml of lukewarm distilled water and titrated against 0.1 N sodium hydroxide using phenolphthalein as an indicator. Following formula (8) used to determined titrable acidity:

$$\text{Percentage titrable acidity} = \frac{T \times N \times V \times E \times 100}{V \times W \times 1000} \qquad (8)$$

Where;
T, N, E, V, v and Ware titrable value in ml, normality of alkali, equivalent weight of reagent in g, volume made up in ml, Volume of sample in ml and weight of sample in g, respectively.

Water solubility index (WSI) and Swelling power

The solubility and swelling index of starch were determined using the method reported by Sharlina *et al.*, (2017), with slight modifications. 0.5 g of dry starch was transferred into avial containing 10 mL of distilled water and stirred using amagnetic stirrer for 30 min before being heated at 50, 60, 70, 80, 90 and 100 °C for 30 min. Then, the starch slurry was cooled toroom temperature, transferred to a centrifuge tube and centrifuged at 1500 rpm for 30 min. Different starch slurries were used for each of the temperatures.

The supernatant from the centrifuge tube was carefully decanted into another vial, and wet starch precipitate was weighed after it was drained for 10 min. The supernatant was dried in an oven at 105 °C until a constant weight was reached. The analysis was performed in triplicate. The solubility and swelling power were calculated using Eqs. (9) and (10).

$$\text{Water solubility index (\%)} = \frac{\text{weight of dissolved starch from heated solution}}{\text{Weight of starch sample}} \times 100 \qquad (9)$$

$$\text{Swelling power} = \frac{\text{Weight of starch paste}}{\text{Weight of dry starch sample}} \times 100 \qquad (10)$$

Results and Discussion

Vitamin B6 in areca nut

The results of Vitamin B-6 in areca samples of Karnataka have been presented in table 1 and 2. In Shimoga district high amount of vitamin B6 was estimated in Anwatti and Kasaba hoblies (52.33 and 47.67 ppm) of Soraba taluk and 10 ppm of vitamin B6 was determined in different hoblies of Shimoga district.

In Chikkamagalur district also 10 ppm of vitamin B6 was determined in different hoblies. The high amount of vitamin B6 was determined in Kigga hobli (72.67 ppm) of Koppa taluk followed by Sakharayapattana hobli of Kadur taluk (69.00 ppm). High amount of Vitamin B6 was estimated in Bilichodu hobli (84.67 ppm) followed by Santhebennuru hobli (55.00 ppm) of Davanagere district.

High content i.e., 72.67 and 68.33 ppm was estimated in Turuvanooru and Bharamasagar hoblies of Chitradurga district. In Dakshina Kannada district highest amount of vitamin B6 was determined in Upinangadi (91.33 ppm) and Surathkal (91.00 ppm) hoblies of Puttur and Mangalore taluks respectively. In Udupi district high amount of vitamin B6 was determined in Ajekaru hobli (81 ppm) followed by Karkala hobli (56 ppm) of Udupi district (Table 1).

Table.1 Physicochemical properties of tikhur powder

S. No.	Properties	Laboratory Grinder	Starch Extraction Machine
1.	Moisture content, (%)	12.95	12.70
2.	Bulk density, (g/ml)	0.79	0.81
3.	True density, (g/ml)	1.64	1.63
4.	Ash content, (%)	0.87	0.96
5.	Fat content, (%)	0.44	0.42
6.	Crude fiber content, (%)	0.64	0.79
7.	Protein content, (%)	1.34	1.49
8.	Total carbohydrate, (%)	85.40	85.43
9.	pH value	7.30	7.40
10.	Titrable acidity, (%)	0.65	0.61

Table.2 Water solubility index and Swelling power of tikhur power at different temperature

Temperature	Swelling power		Water solubility index	
	Laboratory grinder	Starch extraction machine	Laboratory grinder	Starch extraction machine
50^0C	2.946	3.401	8.32	8.17
60^0C	3.663	4.054	12.34	13.69
70^0C	6.579	7.946	23.35	27.29
80^0C	7.359	9.988	48.05	48.59
90^0C	11.202	12.472	68.96	71.12
100^0C	13.976	16.979	81.16	80.76

(a) Cleaning of *tikhur* rhizome

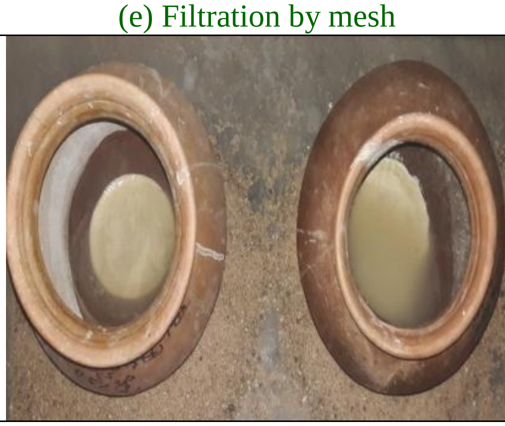
(b) Soaking in solution

(c) Grinding by *tikhur* starch extraction machine

(d) Dispersed in solution

(e) Filtration by mesh

(f) Retained after filtration



(g) Sedimentation of starch

(h) Poring

(i) Starch after drying

(j) Final starch

Fig.1 (a-i) Step by step procedure for starch extraction using starch extraction machine

Fig.2 Determination of moisture content (Moisture analyzer)

The result of physicochemical analysis of the *tikhur* powder extracted by laboratory grinder and starch extraction machine is presented in Table 1. The average moisture content of *tikhur* powder was found to be 12.83% (wb). Ellis *et al.,* (2003) reported that the good quality starch should have moisture content of in the range of 10-13.5% to ensure better shelf life. The results of physico-chemical analysis of *tikhur* powder indicated that it contain about on an average 1.42% protein, 0.43% fat, 0.72% fiber, 85.41% carbohydrate and 0.92% ash, respectively. However, it is possible to have different results based on the location environmental condition soil fertility etc.

Similarly results reported by Paikra *et al.,* (2017) and Patel *et al.,* (2015) for*tikhur* powder. Tiwari and Patel (2013) reported the proximate composition at 13% moisture content was found to be 1.6% protein, 0.9% fat, 84% carbohydrate and 1.2% ash, respectively. Deshpande, (2008) also reported that the rhizomes of *tikhur* contains 69-70% moisture, starch 25-30%, crud protein 1.6%, fat 0.2%, sugar and dextrins 2.1%, crude fibre 3.9 % and ash 0.9%, respectively.

Starch extraction method have slightly rich in every constitute especially in protein and ash content about 0.15 and 0.12 percentage then laboratory grinding method and have no significant variation found. The details are given below in the Table 1.

Water solubility index and Swelling power

From Table 2 shows the water solubility index and swelling powers of *tikhur* starch at temperature in the range of 50–100°C by 10^{o}C intervals. It was depicted that the water solubility index and swelling power of *tikhur* starch increases with increase in temperature. The water solubility index of starch obtained from laboratory grinder and *tikhur* starch extraction machine was higher 81.496%, 81.31% at 100°C temperature and lower 6.65%, 8.85% respectively, at 50°C. The swelling power of starch obtained from laboratory grinder was highest 13.98g/g, at 100°C temperature whereas *tikhur* extracted from the *tikhur* starch extraction machine was found 16.98 g/g respectively, at 100°C temperature. Swelling power of starch depends on the capacity of starch molecules to hold water through hydrogen bonding. The high swelling power results into high digestibility and ability to use starch (Nuwamanya *et al.*, 2011) and also show that the swelling power of starch extracted with chemical treatment is differ from control.

Similar some researchers have reported an increase in water solubility index and swelling power with increase in temperature for *tikhur* (Rani and Chawhaan, 2012, Kumari *et al.*, 2017), tuber (Babu and Parimalavalli, 2012) and ginger (Michael *et al.*, 2014).

In conclusion, the starch obtained from the*tikhur* rhizomes is highly nutritious and easily digestible. In this paper describe the variation of physicochemical properties on *tikhur* powder extracted from rhizome by two different methods such as laboratory grinder and starch extraction machine. Results shows that slightly differ in protein and ash but no more significant variation finds. The data of water solubility index and swelling powers of *tikhur* powder was increased with increasing temperature range from 50–100°C.In concussion the use of both methods for powder extraction are more useful and economical.

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