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Physicochemical and functional properties of *Curcuma angustifolia* (Tikhur): an underutilized starch

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Abstract

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. Starch from *Curcuma angustifolia* rhizome was characterized for its proximate composition, physicochemical and functional properties. This starch recovery per cent 9.49%, moisture 12.53%, protein 1.70%, carbohydrates 85.33% oil 0.39%, bulk density1.04 gm/cc, as starch and negligible amount of fat and protein. Tikhur starch display higher pasting temperature (76.25 °C), suggesting the tendency to form faster paste and stability under high cooking conditions. These properties demonstrate the untapped potential of Tikhur starch for use in food and non-food applications previously dominated by costlier cereal starches.

Keywords: Physicochemical, functional, *Curcuma angustifolia*

1. Introduction

Starch is the most important macromolecule being used diversely to meet technological needs of today due to its low-cost, abundance, edibility, biodegradability and good film forming properties. 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) [13].

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) [18].

The rhizome of Tikhur have great medicinal value. It is well known for its use in ethno medicine as demulcent, antipyretic and blood coagulant. The rhizome of *C. angustifolia Roxb*. can be used to heal peptic ulcers, is used in treatments of dysentery, diarrhoea, and colitis and is often employed as a herbal tonic for patients suffering from tuberculosis. Its use for the treatment cough and bronchitis is very popular in the areas where it grow. The leaves of the plant also yield volatile oil, possessing antimicrobial properties (Rani and Chawhaan, 2012) [14]. It is also reported that the boiled water extract of rhizome is used for treatment of diabetes. The starch of this herb is used for the preparation of several foods such as barfi (Shankar *et al*., 2014) [16], halwa (Banik *et al*., 2014) [4], khoa-jalebi (Kumari *et al*., 2012) [19], and *sarbat* (Singh and Palta, 2004) [18]. Because of its medicinal properties, the starchy flour is used as a weaning food called shotti (Sharma, 2012) [17]. The versatility of Tikhur starch as a base for many food products emphasizes the need for a better understanding of its functional characteristics and attempted in this study.

2. Materials and Methods

Tikhur rhizome was procured from the different genotypes of Tikhur in S.G.CARS Jagdalpur and extracted for starch as mentioned by the procedure of Patel *et al.* (2015) [13]. Extracted starch was used for evaluation of physico-chemical and functional properties.

Physicochemical properties of Tikhur powder
The moisture content was determined by using moisture analyzer. 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.

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. H2SO4 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.

Fat content
The total fat content was calculated by the Soxhlet method as described in the AOAC (1995) [2] 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):

Total carbohydrate
The total carbohydrates were calculated by the by AOAC (1995) [2] method. After determining the percentage of moisture, protein, and fat and total ash content in the developed sample it was calculated as follows.

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.

3. Results and Discussion
Physical and chemical characteristics
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 12.53% (wb). Ellis *et al.,* (2003) [6] 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 1.70% protein, 0.39% fat, 85.33% carbohydrate, and bulk density 1.04gm/cc 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) [11] and Patel *et al.,* (2015) [13] for Tikhur powder. Tiwari and Patel (2013) [19, 20] reported the proximate composition at 13% moisture content was found to be 1.70% protein, 0.9% fat, 84% carbohydrate and 1.2% ash, respectively. Deshpande, (2008) [5] also reported that the rhizomes of Tikhur contains 69-70% moisture, starch 25-30%, crud protein 1.6%, fat 0.2%, respectively.

Table 1: Physicochemical composition of Tikhur starch (g/100g)

Constituents	Tikhur
Moisture (db)	12.53%
Crude fat	0.39%
Crude protein	1.70%
Moisture (db)	12.53%
Bulk density (g/cc)	1.04 gm/cc
Total carbohydrate, (%)	85.33%

Bulk density: Bulk density is a measure of heaviness of solid samples, which is important for determining packaging requirements, material handling and application in the food industry. Bulk density of Tikhur starch is quite lesser than Wheat flour (0.73g/cc) and jackfruit seed flour (0.80 g/cc). Tikhur starch is not suitable as thickener in food products as it is recommended that flours with high bulk densities (> 0.7 g/mL) are used as thickeners in food products (Akubor and Badifu 2004; Falade and Oka for, 2015) [7].

Solubility and swelling index: Heating starch in the presence of excessive amount of water leads to the granule swelling, amylose leaching, and water adsorption. Solubility (SOL) and Swelling index (SI) were directly correlated to increase in temperature. Tikhur starch has acceptable solubility and swelling power of 17.27 g/g and 17.33 mol/dm^3 respectively at 95 °C for use in broad range of processing temperature. Food eating quality is often connected with retention of water in the swollen starch granules (Falade and Oka for, 2015) [7] 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) [14, 18], tuber (Babu and Parimalavalli, 2012) [3] and ginger (Michael *et al.,* 2014) [10].

4. Conclusion
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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