Indian Journal of Natural Products and Resources
Vol. 6(3), September 2015 pp. 213-220

Indigenous processing of *Tikhur* (*Curcuma angustifolia* Roxb.) for the extraction of starch in Baster, Chhattisgarh

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Received 6 November 2014; Accepted 7 August 2015

Curcuma angustifolia Roxb., commonly known as *Tikhur* in Hindi, occurs widely in many parts of India. It is traditionally recognized as medicinal plant and also contains starch in its rhizomes. In some forest tubers, extraction of starch is simple; whereas this is not always so with other tuber starches. An exhaustive survey was conducted in Baster region of Chhattisgarh to explore the traditional practice of extraction of starch from *Tikhur* rhizomes being followed by the tribals/ forest dwellers and to document the same. Information was documented by Participatory Rural Appraisal (PRA) technique followed by live demonstration of the actual methodology. The paper discusses, various unit operations essential in the extraction of starch from *Tikhur* rhizomes. Efforts have also been made to record the traditional knowledge of ethnic people in relation to *Tikhur* starch preparation with due justification and practical implications. The purpose of the investigation was also to provide protection to the knowledge of forest dwellers and document it before it is lost under the onslaught of development process. The knowledge would help researchers, scientists and development workers in adding value to the indigenous knowledge for sustainable development.

Keywords: *Curcuma angustifolia* Roxb., Rhizome, Starch, *Tikhur*, Traditional processing.

IPC code; Int. cl. (2014.01)– C08B 31/00

Introduction

Tikhur (*Curcuma angustifolia* Roxb.) is rhizomatous herb. It is one of over 80 species belonging to the *Curcuma* L. genus in the family Zingiberaceae (which also contains plants such as ginger and turmeric)[1]. This species is native to the Indian subcontinent and is more commonly known as wild or East Indian Arrowroot or narrow-leaved turmeric in English. Its common names in various regional languages are - *yaipan* in Manipuri, *Tikhur* in Hindi, *kovva* in Malayalam, *Tavaksira* in Sanskrit, *Tavakila* in Marathi, *Ararut-kizhagu* in Tamil, *Keturi Halodhi* in Bengali. It is perennial flowering plant, with modest and small spiked inflorescences of three or four yellow, funnel shaped flowers within tufts of pink terminal bracts (como tracts). Flowers are usually seen at the beginning of the rainy season from July to August, before the leaves have had the chance to fully develop and they continue to flower even after the leaves have fully developed. Leaves may grow to about 36-37 cm long and 8-10 cm wide. The leaves also smell and taste similar to turmeric (Plate 1). The great significance of the *Tikhur* plant is its strong rhizome which can grow up to 1.5 m in length. The rhizomes of this plant are the primary source of its nutrition and medicinal properties. In nature, propagation of *Tikhur* occurs through rhizome, which is slow process. The plant grows wild in its natural habitat and usually perpetuated through vegetative reproduction[2].

The plant is most commonly found growing wild in India especially in the North East and western coastal plains and hills. Such areas include the states of Maharashtra, Madhya Pradesh, Andhra Pradesh, Himachal Pradesh, Chhattisgarh, Bihar, Jharkhand, West Bengal, Tamil Nadu and Kerala[3,4]. This species can also be found in Burma, Laos, Nepal and Pakistan[5]. Its major availability is reported in moist deciduous *Sal* and mixed forest of Madhya Pradesh, Chhattisgarh and Jharkhand[3]. The collection of *Tikhur* rhizomes and its traditional processing for the extraction of starch is generally done by the tribal farm families residing in and around the forest areas of these regions. It is worth mentioning here that the traditional processing of *Tikhur* rhizomes in the form

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Plate 1—*Tikhur* plant at flowering stage

of *Tikhu*r starch is cumbersome, tedious and time consuming in addition to drudgery on the other hand, the final processed product per person per day comes to be very meager.

The species is of great nutritional value, especially as a source of starch for Indian foods and medicines. The rhizomes of *Tikhur* are typically ground into flour, which can then be mixed together with milk or water to form a nutritious meal. This flour was a common commercial crop in the 1800s[5]. *Tikhur* rhizomes are used for the preparation of powdery flour which has medicinal value and is effective for many diseases. The powder or the starch is highly nutritive and digestible, therefore, it is recommended for infants, weak children and invalids. Its consumption is very popular by individuals during fasts (*Upwas*) as it is rich in energy. It is used for the preparation of many Indian sweets like *halwa, burfi, jalebi* etc.[3,6]. Its food uses by major tribes, *viz.,* Kamar, Gond and Halba of Chhattisgarh are well described in the literature[7]. *Tikhur sarbat* (herbal drink) is a popular preparation using *Tikhur* starch consumed especially during summer season with an understanding that it works as cooling agent for the stomach and human body. Most importantly, the west has begun to notice its potential as a source of nutrition and as a non-irritating diet for patients suffering from specific chronic ailments, recovering from fevers, or experiencing irritations of the gastrointestinal tract, the lungs, or the excretory system. According to the local healers, *C. angustifolia* Roxb. plant is also used for curing worms and stomachache[8]. A drink including *Tikhur* as an ingredient is also used as a replacement of breast-milk or as a nutritional supplement for babies a short while after weaning. It is found as a primary ingredient in cakes, fruit preserves, biscuits and puddings[9]. The rhizomes 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 an herbal tonic for patients suffering from tuberculosis. Its use for the treatment cough and bronchitis is very popular in the areas where it grows[9]. In addition, scientists have compared the *Tikhur* rhizomes with corn starch. Its binding and disintegration properties make it a viable and perhaps superior substitute for corn starch as an excipient in medicinal tablets[10].

Non-timber forest products (NTFPs) including *Tikhur* play an important role in the livelihood of tribal families as they contribute significantly in sustaining their lives in different ways. Chhattisgarh state of India is the major producer of starch. According to an estimate about 200 MT of *Tikhur* starch is produced and marketed yearly by registered Self Help Groups[11]. In addition, individual collection and domestic processing of *Tikhur* starch is many times more than the recorded collection and processing. Despite of its valuable and important uses, it is sold at a meager price in the market varying from ₹ 300.00 to 500.00 per kg. The literature on the processing of *Tikhur* rhizomes for the production of starch is scanty. Although few research papers are available on the processing of *Tikhur* rhizomes[3,4], to the best of our knowledge, the traditional methods of extraction of *Tikhur* starch has not been documented. The aim of this paper is to record the indigenous knowledge of the ethnic people of Bastar region of Chhattisgarh, India in the preparation/ extraction of *Tikhur* starch and its characterization which will guide the researchers to explore the possibilities of its refinement and mechanization to boost up the activity. Further, in view of its potential value for sustainable development, it is necessary to preserve indigenous knowledge for the benefit of future generation.

Materials and Methods

The study was undertaken to examine various indigenous processes adopted for the production of starch from *Tikhur* rhizomes. The study was conducted in selected localities of Jagdalpur, Dantewada, Kanker, Narayanpur, Bijapur districts of Chhattisgarh state of India. This belt of the state is characterized by dense forest of important trees with intermixture of shrubs and rather small sized trees which are mainly of deciduous type. The preparation and large scale selling of *Tikhur* starch is a normal practice in this area. Agriculture in this belt is highly risk prone with great dependence on rains. People largely depend on the available natural resources as a source of their livelihood.

Information was gathered on collection of raw material (*Tikhur* rhizomes), methods of starch extraction, consumption pattern, storage, marketing, etc. through informal personal interview and observation of actual processing techniques at different sites from various tribal communities and personals involved in the collection of rhizomes and extraction of starch. Information was documented by using Participatory Rural Appraisal techniques like observation and discussion including personal interviews and interaction. The respondents were apprised of the objectives and purpose of study and their consent was taken for the documentation of the traditional practices being studied and its publication and the information they divulged would go into public domain. The selected informants were interviewed through group discussion collectively, so as to ensure on spot folk validation and triangulation of the people. The conversation followed was documented by the researcher. In order to record the actual working sequence of identified indigenous practice, practical session was performed with the traditional processors. In some cases, identified practioners were invited and especially requested to demonstrate the process in detail. The final results were documented along with opinion and expressions of the respondents. The interaction with the field level officials of the state forest department also facilitated the compilation of the information.

The proximate analysis of raw material and final product was done following the standard procedures described by Ranganna[12].

Results and Discussion

Tribes have developed their own processing methods for extraction of starch from *Tikhur* rhizomes. The entire method of starch extraction from the *Tikhur* rhizomes is presented through a process flow chart (Fig. 1). The method described is commonly established and adopted in the villages at cottage level with a little variation in some of the unit operations depending on the understanding of dwellers and

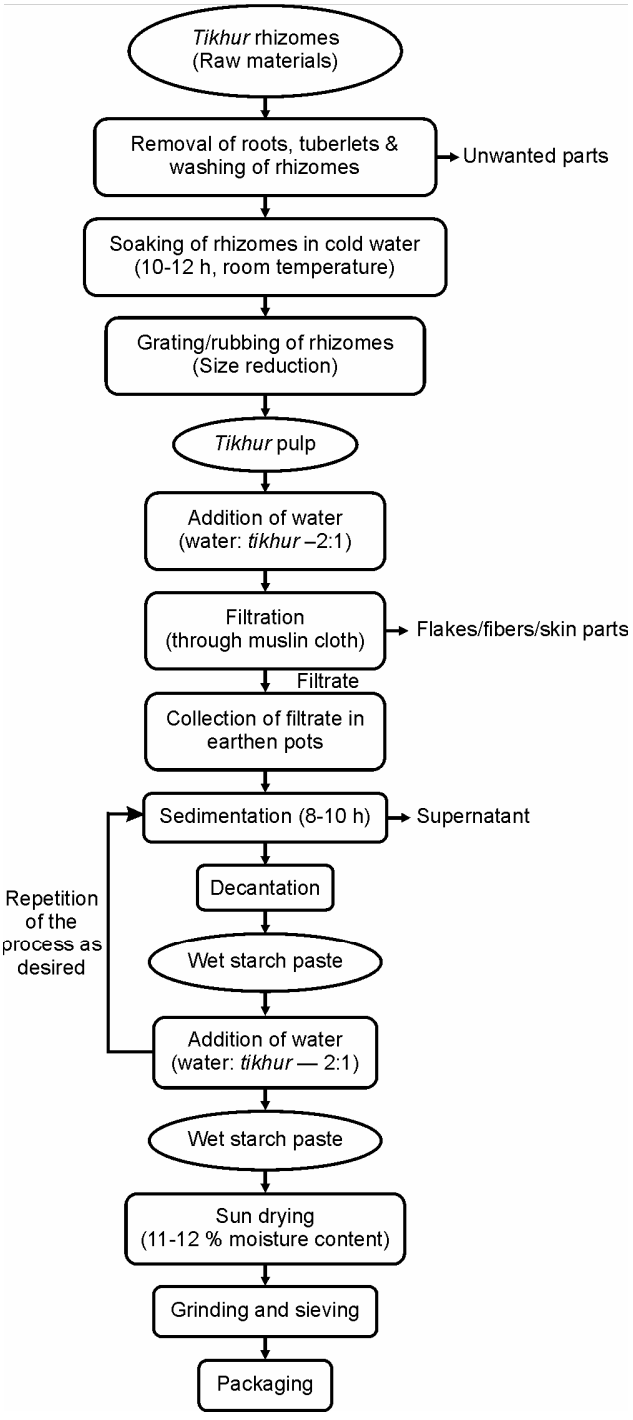

Fig. 1—Process flow chart for *Tikhur* starch production by traditional method

available facilities with them. With the variation in area or the production catchment, a slight variation in different unit operations is also prevalent/followed. The basic unit operations involved in the starch extraction process is: preparation of raw material (rhizomes), soaking of rhizomes in water, grating or rubbing of rhizomes (size reduction), filtration, sedimentation and decantation, drying, grinding (pulverizing).

Raw material and its preparation

Tikhur rhizomes are harvested normally during the month of November to January depending on the weather and soil moisture condition. The harvesting stage or the maturity of the rhizomes is well indicated by the yellow coloured partially dried leaves. The dried leaves are gradually dropped from the plants in case of over or excessive matured rhizomes. Excessive matured rhizomes are not preferred for the extraction of starch as it results comparatively less yield compared to matured ones. Rhizomes are traditionally dug out from the soil with the help of spade, *khurpi* and *kudali* or any other user friendly hand tools. Rhizomes are then detached from the stem portion of the plant with the help of knife; sometimes it is possible by hand when the stem is adequately dried (Plate 2a). Rootlets (hairy roots), tuber lets are separated from the rhizome bulbs and adhered soil particles are also cleaned to the possible extent. The fresh rhizome bulbs so obtained are then washed thoroughly with running water or washed two to three times in case of absence of running water. The rhizome bunch includes the main rhizome bulbs known as mother rhizomes and finger rhizome bulbs attached to the mother rhizomes. (Plate 2b) The mother rhizomes are separated from the finger rhizomes with the help of knife to facilitate easiness in the further operations.

Grading of rhizomes into different grades and sub-grades such as bigger and smaller sizes, mother rhizomes and finger rhizomes is also followed by some of the processors but is optional as this is not essentially practiced by all the processors. In the practical session, separate trials were performed for different grades of the rhizomes. The observations of the experiment indicated that the yield of starch increased by 2-3 % in case of mother rhizomes than that of finger rhizomes. On the other hand, there was no appreciable difference in the quality of starch particularly the colour (whiteness) and fineness of the powder. However, this needs further investigation and validation. Further, the detailed evaluation of quality of starch obtained from different grades of rhizomes need to be exercised to arrive at any conclusion.

Soaking of rhizomes

Cleaned and washed rhizomes are soaked in water at room temperature in vats or the buckets for 10 to 12 h. Normally rhizomes are soaked for overnight because soaking enhances the tenderness of the rhizomes; softness of the rhizomes facilitates easy grinding/rubbing of the rhizomes. Soaked rhizomes are then peeled out. Soaking also helps in easy peeling of outer skin of the rhizomes. Peeling of outer skin is also optional. There are two schools of thoughts among the processors on peeling; one school of thoughts is that the peeling out of skin prior to processing improves the quality of the final product whereas other group believes that peeling causes the loss of starch and reduction in yield. However, this needs to be investigated in greater detail for further knowledge.

Grating or rubbing (size reduction) of rhizomes

Grating of rhizomes refers to the grinding or rubbing or size reduction of rhizomes to form a paste like mass. There are two methods of grinding or grating of rhizomes widely used by the traditional processors, viz. (i) rubbing of rhizomes on rough stone surface and (ii) rubbing of rhizomes over rough steel screens/sieves (Plate 2c-d). This is an essential unit operation performed to convert the rhizomes into paste like mass known as *Tikhur* pulp. The process is tedious and cumbersome as rubbing of rhizomes is done by hand. During the process, efforts are made to grate the rhizomes in such a way that the resultant final grated mass should be as fine as possible. It is believed that fine rubbing or grating of rhizomes increases the starch yield and improves the quality as well particularly the colour (whiteness) and fineness. It is worth mentioning here that no appreciable difference in yield and quality of *Tikhur* starch was observed in the two methods of rubbing or the grating. However, there is a need to study the effect of size reduction method on quality of the starch.

Filtration

Pulp obtained after rubbing or grating of rhizomes is converted into solution with the addition of water in the ratio of 1:2 (pulp:water) or even little more and stirred well to make a homogeneous mass. This solution is left for some time which further helps in

Plate 2—Starch preparation from *Tikhur*. (a) *Tikhur* rhizomes at harvesting stage, (b) *Tikhur* rhizomes, (c) Grating/rubbing of *Tikhur* rhizomes on rough stone surface, (d) Grating/rubbing of *Tikhur* rhizomes using steel screen, (e) Filtration of grinded rhizome pulp and (f) Sedimentation of filtrate

detaching the starch particles and subsequently dissolved into solution. The idea is to make milky solution of dilute consistency with the assumption that maximum starch part of the paste will be dissolved and upon filtration maximum starch particle will passed through (recovered). The solution so prepared is then subjected to filtration using muslin cloth (Plate 2e). The filtrate is collected in earthen pots, during filtration the solution is continuously stirred to ensure the maximum collection of dissolved starch particles in the filtrate. The substrate on the cloth which contents flakes, fibers and parts of skin is thrown away.

Sedimentation and decantation

Sedimentation is the process of settling the starch particles and decantation is the process of separating supernatant from the starch mass. Traditionally this process is known as the washing and purification of the starch mass in the tribal community. This is

necessary for two reasons; one to diminish the sourness/bitterness of the starch and to improve the whiteness of the product which otherwise yields the starch of undesired taste with dull colour. The colour and taste both significantly affect its marketing and consumers acceptance.

The filtrate collected in the earthen pots containing the starch particles are allowed to settle (sediment) for about 12 h (Plate 2f) followed by draining out the supernatant (Plate 3a) safely at slightly low temperature to overcome fermentation. While draining sufficient precaution is taken and ensuring that the water does not contain any starch particle. The left over white wet mass (thick semi solid liquid) of starch is further diluted with the addition of enough water (about 2.5 to 3 time of its volume) and stirred well. This is again left for 6-8 h for settlement followed by decantation in the similar way. This process of sedimentation and decantation is repeated 6 to 8 times depending on the colour of the paste or the starch mass. Finally the excess water is drained out to the maximum possible limit and the left over white thick semi solid wet mass of starch is obtained (Plate 3b). The numbers of decantation improves the colour of the starch and also minimize the sourness/bitterness but on the other hand there always exists the chance of starch loss and the magnitude of which depends on the skill of the worker.

Drying

White thick semi solid mass of starch obtained after final decantation is subjected to sun energy. The thick semi solid liquid mass of starch obtained after final decantation is then poured and spread on plates

Plate 3—Starch preparation from *Tikhur*. (a) Decanting/Draining of supernatant, (b) Collecting/pouring of wet starch, (c) Sun drying of *Tikhur* starch, (d) Dried *Tikhur* starch, (e) Grinding of dried *Tikhur* starch and (f) Packets of *Tikhur* starch

Table 1—Characteristics and proximate composition

S. No.	Particulars	Values	
		Tikhur rhizomes	*Tikhur* starch
1.	Moisture content, % (wb)	71-76	11.5-13
2.	Bulk density, kg/m^3	796 - 815	468- 475
3.	Colour of the rhizome/bulb	Brownish yellow	White
4.	Protein, %	1.5 -1.7	1.6
5.	Fat, %	0.17-0.19	0.9
6.	Carbohydrate, %	21.78-23.44	82-85
7.	Ash, %	0.88-0.92	1.0

(baked clay or aluminum or any other material) in thin layers and placed in open area for drying in sun light (Plate 3c). Drying of starch is done continuously till the moisture content of the starch mass is sufficiently reduced and further drying do not take place under the prevailing atmosphere. Upon drying the starch mass turns to fragile state which is converted into powder. The moisture content of the finally dried starch product varied from 10 to 12% (wb) (Plate 3d).

Grinding or crushing

The dried starch is grinded/crushed or pulverized with the help of a wooden pastel or by the wooden kitchen *belan* to make fine free flowing powder (Plate 3e). The dried starch being light and fragile/brittle easily converted into powder, sometimes it is crushed by hands also. The starch powder is then filled and packaged in good quality polyethylene bags and stored well in dry place (Plate 3f).

Observation on the demonstration

Proximate analysis of the freshly harvested *Tikhur* rhizomes is given in Table 1. It contained nearly 22 to 23 % of carbohydrate at rhizome moisture content of 71 to 76 % (wb). The protein and fat contents were 1.6 and 0.18 %, respectively. Following the traditional method of starch extraction as described in the preceding paragraphs nearly half of the starch in the range of 11.10 to 14.73 % could be obtained. The variation is mostly affected by the number of decantation. Increased number of decantation adversely affected the starch recovery. The contribution of grating method might have some effect on the recovery but this was not evaluated and needs to investigate systematically. On the other hand, brightness or the whiteness of the starch improved with the increased number of decantation; however, higher yield of 2-3 % starch was obtained when the graded mother rhizomes were subjected to processing. The result of proximate analysis of the *Tikhur* starch is presented in the Table 1. The results of proximate analysis of *Tikhur* starch indicated that it contains about 82-85 % carbohydrate, 1.6 % protein and less than 1 % fat. It was possible to process approximately 20-25 kg of freshly harvested rhizomes in a day by a pair of workers. 2-3 days of sun drying was required for 1-1.5 cm thick starch mass spread over metal plate to a safe moisture level of 11.5-12.5 % (wb). The samples collected for the present study represented various preparation lots by different people at different times. In spite of this, the product (*Tikhur* starch) recorded almost uniform values in parameters like moisture, protein, fat, carbohydrate content. This indicates that the traditional tribal processors follow a well tested standard method for extraction of *Tikhur* starch.

During the demonstration session the critical unit operations observed were the grating or rubbing of rhizomes to form fine paste and the decantation. Both the unit operations required a good skill of the workers. It was observed that all the members of the family are well acquainted with the art and had developed the skill. Considering the gender, female workers had a better understanding of the process and skill of different unit operations.

Conclusion

The processing and value addition technique of *Tikhur* rhizome by the tribal community is an indicative of their rich culture and art. The method being practiced by the processors at cottage level is very tedious and cumbersome but on account of their basic need as food supplement in addition to various therapeutic values the extraction of *Tikhur* starch is a part of their life. This is also true that it supports their livelihood. The low remuneration from the extraction of *Tikhur* starch due to lower range of recovery is discouraging the younger generation. This preliminary study, therefore, aims at to draw the attention of researchers and engineers for undertaking broad and elaborative studies on the extraction of *Tikhur* starch. Integrating this indigenous knowledge system in to the research could develop appropriate new modern techniques involving machineries to make the process scientific and bring improvement on the existing process for its sustainable up-scaling at larger scale. Further, the gap between the domestic production and the requirement become widened at an alarming rate. This warrants the establishment of

strong linkages among the tribal collectors, processors, researchers, development officials which will lead to the success of the local enterprises. Additionally, there should be focused effort to educate younger generation on traditional knowledge and traditional foods.

Acknowledgement

We thank all the tribal people who shared their traditional knowledge with us to compile this manuscript. The financial and administrative help received from Indira Gandhi Krishi Vishwavidyalaya, Raipur is highly acknowledged. The guidance and support received from Dr. S K Patil, Vice Chancellor, IGKV, Raipur is highly acknowledged. The help and technical suggestions received from Dr. D S Ram, Scientist, SG College of Agriculture and Research Station, Jagdalpur and Dr. Jitendra Singh, Professor and Head, Department of Vegetable Science, College of Agriculture, IGKV, Raipur is appreciated.

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