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Wild species of *Curcuma* as potential source of starch powder for traditional dishes

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Abstract

The genus *Curcuma* L. (Zingiberaceae), distributed throughout south and south east Asia with about 104 species, is a minor tuber crop and an under-utilized source of starch. In India, south India is the main center of distribution of the genus. Some of the rhizome producing *Curcuma* species are excellent sources of starch and are utilized by local or tribal people for the preparation of different traditional dishes. In view of this, in the present study five different rhizomatous wild *Curcuma* species from south India were collected and their rhizome starch powder was isolated by traditional method with slight modifications. Nutritional composition with respect to the total carbohydrate, crude protein, fat, fiber, ash and energy content of the isolated starch powder was determined. Using the isolated starch powder, different traditional dishes/beverages of south India were prepared *viz*. *Ela-ada* (*C. amada*), Gruel (*C. aeruginosa*), *Halwa* (*C. zanthorrhiza*), *Payasam* (*C. zedoaria*) and *Sarbat* (*C. aromatica*) and their sensory features with respect to appearance, colour, taste, aroma and overall acceptability were evaluated. The results revealed the suitability of *Curcuma* starch in traditional dishes and is endorsed to widen its food application and value addition.

Keywords: *Curcuma, Ela-ada*, Gruel, *Halwa, Payasam, Sarbat*, Starch

1. Introduction

The genus *Curcuma* (Family: Zingiberaceae) comprises over 104 species (Mabberley, 2017) of rhizomatous herbs, endowed with widespread distribution in south and south east Asia extending to Australia and South Pacific. Its highest diversity is in India with the main centre of distribution in south India with approximately 20 species (Sabu, 2006). In addition to the medicinal potential of the genus, several rhizome producing species of *Curcuma* are rich source of starch, a major dietary source of energy (Velayudhan *et al.,* 1999; Policegoudra and Aradhya, 2008; Policegoudra *et al*., 2011). However, the genus has not been much exploited as source of starch (Rajeevkumar *et al*., 2010) but, some *Curcuma* species were used traditionally by limited rural people or tribes.

Tribal people use starch from different *Curcuma* species because of its cooking quality and considering its availability. *C. aeruginosa* starch powder is used in south India for the extraction of 'Travancore starch' (Leong-Skornickova *et al*., 2007) and is used against infantile diarrhoea. Starch powder from *C. zedoaria* called 'Shotti starch', is valued as an article of diet for infants and invalids in countries like Indonesia, Thailand, China and Vietnam (Mukherjee and Bhattacharya, 1945). In northern parts of India, *C. angustifolia* (east Indian arrowroot) starch powder is recommended for old and sick people during

convalescence (Sabu and Skornickova, 2003). During investigations, the authors observed that the rhizomes of *C. aeruginosa, C. aurantiaca, C. haritha, C. zanthorrhiza* and *C. zedoaria* are being consumed as arrowroot by rural people and tribes, isolating starch powder from it. The widely used arrow root is the starch from the rhizomes of *Maranta arundinacea*, which is a native to tropical America. The literature related to its nutritional composition, health benefit, etc., are meagre. Therefore, the present study assessed the nutritional composition of starch powder isolated from selected wild *Curcuma* species.

Starch powder is the main constituent of many food items because of its easy digestibility and fine texture. It is used as a thickener, gelling agent and binding agent which provides texture to great diversity of food stuffs such as soups, potages, sauces and processed foods (Talele *et al*., 2015). Conventional and commercial starch powder from grains and some tuber crops are the main ingredient in the preparation of bread, pancake, noodles, pasta, etc. It is reported that, starch powder isolated from *C. zanthorrhiza, C. aeruginosa* and *C. phaecaulis* are used for the preparation of salads and soups (Prana and Hawkes, 1981). Tribal people use *C. angustifolia* starch powder for the preparation of milk puddings (Rani *et al*., 2010; Rani and Chawhaan, 2012). Now a days this starch powder is used in north-east India for the preparation of many sweet dishes like *halwa, burfi, jalebi* and *sarbat* (Singh and Palta, 2004), as well as soups and puddings (Franklin *et al.*, 2017). *C. leucorrhiza* starch powder is also used for the preparation of many confectionary items (Nedunchezhiyan *et al.*, 2005) and '*Palo laddu*', a herbal dish is used during fasting (Hansdah *et al.*, 2015). Considering these spectrum of possibilities, the present study focused on the development of some traditional dishes based on modified recipes in which starch powder isolated from different wild *Curcuma* species in south India, replaced the popular conventional flours from rice, wheat or corn. The present study evaluated the nutritional value of starch and palatable qualities of dishes.

2. Materials and Methods

Five *Curcuma* species *viz. C. aeruginosa* Roxb. (TBGT 83451), *C. amada* Roxb. (TBGT 93668), *C. aromatica* Salisb. (TBGT 93669), *C. zanthorrhiza* Roxb. (TBGT 83452) and *C. zedoaria* (Christm.) Roscoe. (TBGT 93672) were collected from different parts of south India and their voucher specimens were deposited at Herbarium (TBGT) of JNTBGRI. Their rhizomes were collected for starch isolation on maturity (October-January) (Fig. 1).

Fig. 1. Wild *Curcuma* species and its rhizome: A, A1- *Curcuma aeruginosa*; B, B1- *Curcuma amada*; C, C1- *Curcuma aromatica*; D, D1- *Curcuma zanthorrhiza*; E, E1- *Curcuma zedoaria*

2.1. Starch isolation

Starch powder was isolated from the rhizomes of *Curcuma* species by traditional method with slight modifications (Kokate, 1994). The rhizomes were thoroughly washed, cleaned and chopped in to small pieces and made in to a smooth paste by grinding. The paste was then mixed with water and filtered through fine cotton cloth, allowed to settle and decanted after 8-12 hrs. The residue was again washed, allowed to settle and the process was repeated 4-5 times until the residual water becomes pure. The water was decanted and the settled starch paste was sun dried till it was moisture free and the powder was stored in air tight containers for further use.

2.2. Nutritional composition

Nutritional analysis in order to determine crude protein, fat, fiber and ash content were carried out using AOAC (2000) standard methods. The total carbohydrates were calculated by the 'By-difference' method as described in the AOAC (1995). Energy content was calculated using Atwater Formula (FAO/ WHO/ UNO, 1985).

2.3. Traditional dishes developed

Five traditional dishes were prepared using the isolated starch powder from the rhizomes of five different *Curcuma* species. Five different types of dishes *viz. Ela-ada* (*C. amada*), Gruel (*C. aeruginosa*), Halwa (*C. zanthorrhiza*), *Payasam* (*C. zedoaria*) and *Sarbat* (*C. aromatica*) were tried. All the traditional dishes were prepared according to the standard recipes with desirable modifications and suitable ingredients. For maximum diversity, starch from various species of *Curcuma* was used in each dish, but it was observed that starch from selected species is suitable for different dishes.

2.4. Evaluation of dishes

The respondents include persons under age group of 25-55 representing different categories of staff from Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), Palode, Thiruvananthapuram. Samples of dishes prepared were presented and served with its title and without revealing the ingredients and their opinion collected in the evaluation sheets separately and they were asked to rate their assessment on 6 parameters in a 5 point hedonic scale (1= dislike extremely, 2= dislike slightly, 3= neither like nor dislike, 4= like slightly and 5= like extremely). The score 3 or above was considered as a bench mark on acceptability for each parameter of the sensory attributes tested. Thus, in the total mean score of a dish, score 20 was considered as the benchmark of the acceptability of the dish. Qualitative suggestions/ comments were also noted and based on it some recipes were modified and improved.

3. Results and Discussion

3.1. Nutritional composition

Nutritional composition of starch from selected *Curcuma* species showed the presence of high percentage of carbohydrate (above 98%) and very low crude protein (0.19-0.56%), fat (0.12-0.36%), fiber (0.12-0.24%) and ash (0.13-0.19%) (Table 1). Though the colour and aroma of rhizomes from different species varied, the taste of the starch was almost same. The findings of the study matched the observations of Yograj (2017) on the starch powder isolated from *C. angustifolia*. The ash content is the estimate of mineral or inorganic component in the starch, the low ash level is regarded as a measure of good quality or grade of the flour and often a useful criterion in the authenticity of the food (Aurand *et al*., 1987). Thus the observation supported the nutritional significance of the selected starch powder. All the starch powders studied were with comparatively high energy content/calorific value ranging 1320.53-1366.27 KJ (Table 1). High energy starch powder can be utilized as potential food for infants, old and sick people for instant energy and is used in the gluten free infant food products to aid people with celiac disease (Kumari *et al*., 2017). All the results indicated the potential of these lesser known, sources of good quality edible starch.

Different traditional dishes were developed using the isolated starch powder as shown below. In the recipes, the starch powder was used as a substitute to rice/wheat flour.

3.2. Traditional Dishes

3.2.1. *Ela-ada* (Fig. 2A)

It is a steamed traditional dish in Kerala.

Source of starch powder: *C. amada*

Ingredients: Starch powder (2 cups), grated jaggery (½ cup), grated coconut (1 cup), water (¼ cup), cardamom powder (1/4 tsp), ghee (1tsp), salt (1 pinch) and banana leaves.

Table 1. Nutritional composition of starch powder from *Curcuma* species

Sl. No.	Species	Total Carbohydrate(%)	Crude Protein (%)	Crude Fat(%)	Crude Fiber(%)	Ash (%)	Energy (KJ)
1.	*C. aeruginosa*	98.68±0.01	0.19±0.00	0.12±0.00	0.12±0.00	0.13±0.00	1346.02
2.	*C. amada*	98.95±0.01	0.25±0.00	0.26±0.00	0.17±0.01	0.16±0.00	1354.89
3.	*C. aromatica*	98.81±0.00	0.56±0.00	0.09±0.00	0.13±0.00	0.15±0.00	1320.53
4.	*C. zanthorrhiza*	98.77±0.01	0.31±0.00	0.36±0.00	0.24±0.00	0.19±0.01	1366.27
5.	*C. zedoaria*	98.54±0.00	0.37±0.00	0.21±0.00	0.21±0.00	0.14±0.00	1347.60

Method of preparation: Water and salt were added to the sieved starch powder and made a soft dough. The banana leaf was sliced into rectangular pieces and cleaned. The grated coconut, jagerry, ghee and cardamom powder were mixed and kept aside as filling. A part of the prepared dough was taken and spread over the leaves, as a thin sheet. The coconut-jaggery mixture was spread as a layer over the dough and the leaf folded breadth wise. The same was repeated with the rest of the dough. All the filled and folded leaves were placed in a traditional steamer and cooked for 30 min and served hot.

3.2.2. Gruel (Fig. 2B)
It is a light porridge, good for babies, old and sick people.

Source of starch powder: C. aeruginosa

Ingredients: Starch powder (¼ cup), sugar (4 tbsp), coconut milk (¼ cup), milk (¼ cup), water (¼ cup), ghee (1 tsp), cardamom powder (¼ tsp), cashew nut (¼ cup), raisins (¼ cup) and salt (1 pinch).

Method of preparation: The milk was boiled. Starch powder, salt and sugar thoroughly mixed and made into a paste by adding water. The paste was gradually added into the boiling milk, stirred well, continuously boiled and cooked for 10 min, until it became a semi-fluid. Once it was completely cooked, removed from the flame, again coconut milk was added and stirred. Cashew nut and raisins fried in ghee and the cardamom powder were added. It was mixed well and served fresh and hot.

3.2.3. *Halwa* (Fig. 2C)
It is a very popular traditional recipe, prepared specially as a sweet on Indian festivals and feasts.

Source of starch powder: C. zanthorrhiza

Ingredients: Starch powder (2 cups), grated jaggery (½ cup), coconut oil (2 tbsp), water (1 cup), ghee (3 tbsp), cardamom powder (¼ tsp), cashew nut (¼ cup) and salt (1 pinch).

Method of preparation: Starch powder was mixed with water, grated jaggery and salt, boiled until it became a paste. Coconut oil and cardamom powder were added and it was stirred well continuously to make a semi-solid consistancy, then ghee was added and mixed well. The mixture was shaped by spreading it uniformly in a tray of suitable size and garnished with chopped, fried cashew nut and allowed to set for 3 hours. It was sliced and served.

3.2.4. *Payasam* (Fig. 2D)
A semi-colloid sweet dish generally prepared on special occasions.

Source of starch powder: C. zedoaria

Ingredients: Starch powder (1 cup), sugar (4 tbsp), water (1 cup), milk (1 cup), ghee (1 tbsp), cardamom powder (¼ tsp), grated coconut (1 cup), cashew nuts (¼ cup), raisins (¼ cup) and thin coconut slices (fresh) (1 tbsp) and banana (fresh, sliced) (1 tbsp).

Method of preparation: The starch powder was mixed with water and sugar, stirred well and cooked until it became thick. Coconut slices, cashew and raisins were fried in ghee separately and added into the mixture along with boiled milk, slices of banana, cardamom powder and ghee and mixed well.

3.2.5. *Sarbat* (Fig. 2E)
It is a refreshing drink mainly consumed during summer.

Source of starch powder: C. aromatica

Ingredients: Starch powder (¼ cup), sugar

(3 tbsp), water (1 cup), milk (2 cup), cardamom powder (¼ tsp), basil seeds (1 tbsp) and salt (1 pinch).

Method of preparation: Basil seeds were cleaned and soaked in water. Starch powder, milk, water and salt were mixed well, boiled and cooled. Cardamom powder and soaked basil seeds were added into it and then served cool.

3.3. Sensory evaluation report

Sensory evaluation of all the prepared dishes to assess the palatable quality was done to explore and broaden the food application of these lesser known starch powders. *Ela-ada* prepared using *C. amada* starch powder acquired 25 total mean score in sensory evaluation. The gruel prepared using the starch powder of *C. aeruginosa* acquired highest total mean score of 30 indicating its high suitability. Halwa made of starch powder of *C. zanthorrhiza* also acquired good acceptability in sensory evaluation among the respondents, with a total mean score of 30, indicating the suitability of the starch powder for halwa preparation. The positive comment obtained for the product was the quality was maintained at par with the commercial Halwa. *Payasam* and *Sarbat* prepared using the starch powder of *C. zedoaria* and *C. aromatica*, also acquired highest mean score 5 for all the parameters and a total of 30, indicating its potentiality and acceptability.

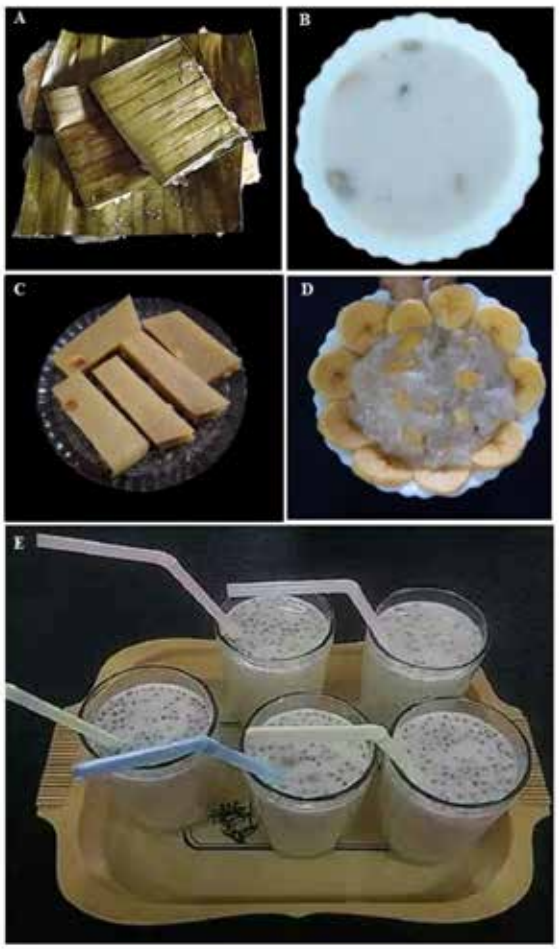

Fig. 2. Tradtional dishes developed: A. *Ela- ada* (*C. amada*); B. Gruel (*C. aeruginosa*); C. *Halwa* (*C.zanthorrhiza*); D. *Payasam* (*C. zedoaria*); E. *Sarbat* (*C. aromatica*)

4. Conclusion

The starch powder from selected *Curcuma* species used in different traditional dishes are of high nutritional value and are rich energy sources which could provide health benefits. All the recipes tested and the dishes prepared using starch powder from different *Curcuma* species received good acceptance with above 4 mean score for each parameter and total mean score above 24 by the respondents, indicating its potential for food applications. The different dishes tested replaced completely the conventional flours of rice, wheat or maize especially '*maida*', the refined wheat flour, which is a very unhealthy food item (Gowri *et al*., 2015). These wild *Curcuma* species are comparatively easier for cultivation, and may be exploited as potential source of edible starch. Therefore, the present study highlights the need for detailed practical trials to explore the possibilities of these lesser known source of edible starch towards harnessing health security.

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