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# Studies on suitability of wheat flour blends with sweet potato, colocasia and water chestnut flours for noodle making

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ABSTRACT

Blends of refined wheat flour (RWF) with colocasia (CF), sweet potato (SPF) and water chestnut (WCF) flours respectively at replacement level of 25 g/100 g were assessed for their suitability for noodles making. All the native flours as well as their blends with RWF exhibited restricted swelling behavior. Incorporation of SPF or CF into RWF decreased the peak viscosity of flour blends. Noodles prepared from respective flour blends of SPF and CF with RWF showed lower cooking time, higher cooked weight, higher water uptake and higher gruel solid loss in comparison to control sample (RWF noodles). Among blend flours noodles, RWF and SPF blend noodles were rated superior for their organoleptic/eating characteristics of slipperiness, firmness, appearance but undesirable high value of tooth packing. Noodle with acceptable quality characteristics and decreased level of gluten, which may prove beneficial for celiac persons, can be developed using RWF blends with non-conventional flours like colocasia, sweet potato and water chestnut.



## 1. Introduction

The popularity of noodles particularly in Asian countries is increasing because of their simple preparation, desirable sensory attributes, long shelf life augmented with product diversity and nutritive value. As the world market is expanding, studies for the development and improvement of noodles qualities satisfying consumer demands is of immense importance. Wheat flour is the main ingredient used in manufacturing of noodles and therefore, characteristics of wheat flour are important for noodle making. In recent years, the demand to use novel sources as substitute for wheat flour has increased. Therefore, flours from alternative sources such as sweet potato, water chestnut and other tubers including colocasia are being used as potential wheat flour substitutes for noodle making adding variety and functionality to the product. Tubers and roots are important sources of carbohydrates as an energy source and are used as staple foods in tropical and sub tropical countries (Liu, Donner,Yin, Huang, & Fan, 2006). These products have nutritionally beneficial components, such as a resistant starch and mucilage. Also tubers and roots do not contain any gluten, and these are rich source of carbohydrates in the form of starch, which plays important role in establishing the textural properties of products like noodles. Therefore, using tubers in the noodles as a source of carbohydrate like starch instead of gluten, may aid in a reduction in the incidence of celiac disease or other allergic reactions (Rekha & Padmaja, 2002).

Researchers have tried to use various composite flours based upon wheat flour substitution for noodle making including sweet potato flour (Collado & Corke, 1996; Collins & Pangloli, 1997; Reungmaneepaitoon, 2009), garbanzo bean flour (Lee, Baik, & Czuchajowska, 1998), soy flour (Lateef, Christiana, & Silifat, 2004; Singh, Chauhan, & Bains, 1989), cassava (Lateef et al., 2004; Perez & Perez, 2009), millets (Devaraju, Begum, Begum, & Vidya, 2008; Vijaykumar, Mohan Kumar, & Srinivasan, 2010). There is now a renewed effort to broaden the food base in developing countries by creating new food products based on indigenous raw materials such as sweet potato, colocasia etc. *Colocasia esculenta*, commonly known as "taro" has much potential for use in food formulations (Njintang, Mbofung, Balaam, Kitissou, & Scher, 2008). Indeed, taro has been shown to be an important ingredient in the production of desserts and miscellaneous taro based products. There is thus generally thought to be much potential for partial substitution of wheat flour with taro in order to diversify and upgrade taro use in non-wheat-producing countries (Njintang et al., 2008). Chestnuts are made up of primarily complex carbohydrate and have a low

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glycaemic index (GI). They are gluten free and their protein is of very high quality, comparable with eggs.

Apart from value addition, through novel food products development there is also scope for variety, convenience and cost efficiency. Most snack foods being cereal based are monotonous in regard to their nutritional quality. Use of abundant supplies of sweet potato, colocasia and water chestnut in countries like India to substitute partially for wheat flour in quality products like noodles will not only reduce the excessive dependence on cereal grains but also improve the imbalance of nutrients through consumption of products based upon composite flour mixtures. Therefore, keeping in view of the above facts and market prospects of the composite flour noodles, this study was planned with the objectives to assess the functional properties of the native and composite flours along with assessment of quality characteristics and consumer acceptance of noodles developed.

## 2. Materials and methods

Sweet potatoes, colocasia and dried water chestnut were purchased from local market in Sirsa (India). The sweet potato and colocasia flours were prepared by method as prescribed by Alves et al. (2002). The sweet potato/colocasia fruits were peeled, washed, cut into cubes of 1–2 cm size, and sliced into thick chips (~5 mm). These chips were then soaked in sodium metabisulfite (0.075%) for ~5 min and oven dried at 30 °C for 40 h to reduce the moisture content to about 13%. Subsequently, the dried chips were milled into flour using laboratory flour mill and sifted through a 75-μm sieve. For making water chestnut flour, dried water chestnut were milled into flour using laboratory flour mill and sifted through a 75-μm sieve. The flour samples were packed in to air tight containers for further use.

### *2.1. Physico-chemical properties of flours*

The chemical composition of the flour samples was determined using standard methods (AOAC, 1984). The flours samples were analyzed for their water and oil absorption capacity, gelation capacity, swelling power and solubility and pasting properties. Water and oil absorption capacities were determined using method of Sosulski, Humbert, Bui, and Jones (1976) and expressed as the weight of water or oil bound by 100 g dried flour. Least gelation concentration (LGC) was determined by slightly modified method of Coffman and Garcia (1977). The flour dispersions ranging from 2 to 33 g/100 ml concentrations prepared in 5 ml distilled water were used for determining the concentration when the sample from inverted tube did not slip. For determining swelling power and solubility of the flour samples, known amount of dry flour (0.5 g) was dispersed in 15 ml of water and the dispersion was heated under mild agitation at 80 °C for 30 min. The gelatinized dispersion was then centrifuged at 3000 × *g* for 15 min and the supernatant was decanted and dried at 100 °C until a constant weight was reached. The swelling power and solubility were determined using the given standard equations and the results were expressed as g/g of dry flour.

### *2.2. Pasting characteristics*

Pasting behavior of flour was investigated using Rapid Visco-analyzer (RVA; series 4D, Newport Scientific, Australia). The dispersion was prepared by dispersing 3 g flour in 25 ml of distilled water. The temperature profile was started from 50 °C for 1.25 min followed by raising the temperature linearly to 95 °C in 3 min and 45 s (heating rate 12.0 °C/min), holding for 2 min and 50 s, cooling the system to 50 °C in 3 min and 45 s and holding at 50 °C for 1.25 min. The pasting curve obtained were analyzed using a RVA Starch Master Software setup Tool (SMST) to obtain the characteristic parameters like pasting temperature ($P_{Temp}$); peak viscosity (PV); hot paste viscosity (HPV); cool paste viscosity (CPV); breakdown (BD = PV − HPV); setback (SB = CPV − PV) and consistency (CS = CPV − HPV), stability ratio (HPV/PV) and setback ratio (CPV/HPV).

### *2.3. Preparation of noodles*

Experimental samples of noodles were prepared with RWF (control) and respective blends of RWF with sweet potato flour (SPF), colocasia flour (CF) and water chestnut flour (WCF) prepared at 25 g/100 g level of substitution as used by Collado and Corke (1996). Dough of optimum desirable consistency was prepared by mixing 200 g flour with purified water in a laboratory dough mixer. The noodles were prepared by extruding dough through a hand operated extruded machine (Sanco, New Delhi, India). The noodles air-dried at room temperature for one day and stored in sealed polyethylene bags.

### *2.4. Cooking properties of noodles*

#### *2.4.1. Cooking time*

Noodles (10 g) were cooked in 200 ml of boiling distilled water in a 250 ml beaker. Noodles were cooked until disappearance of white core as judged by squeezing between two glass slides.

#### *2.4.2. Cooked weight*

The cooked weight of noodles was determined as described by Galvez and Resurreccion (1992) with minor modifications. Noodles (10 g) were soaked in 300 ml water for 5 min and then cooked in water bath for 5 min. The beaker was covered with aluminum foil to minimize the loss of water due to evaporation. The cooked noodles were drained for about 2 min, rinsed with distilled water in a Buchner funnel and cooked weight was determined by weighing wet mass of noodles.

#### *2.4.3. Gruel solid loss (g/100 g)*

The cooked noodles were drained and rinsed with distilled water (50 ml) in a Buchner funnel. The Gruel solid loss was determined by evaporating to dryness the cooking and rinse water in a pre-weighed petri-plate in an oven at 110 °C for about 12 h (Galvez & Resurreccion, 1992). The residue was weighed after cooling in a desiccator to determine gruel solid loss.

#### *2.4.4. Water uptake percentage (g/100 g)*

The water uptake is the difference in the weight of cooked noodle versus uncooked noodles, expressed as the percentage of weight of uncooked noodles (Galvez & Resurreccion, 1992). Cooked noodles were rinsed with cold water and drained for 30 s then weighed to determine the cooking gain. The analysis indicates the amount of water absorbed by the noodle during cooking process.

### *2.5. Textural properties of cooked noodles*

Noodles (10 g) were cooked for optimum time in 250 ml of boiling distilled water and then rinsed with cold water. The textural properties of cooked noodles were evaluated by texture profile analysis (TPA) using the TA-XT2 Texture Analyzer (Stable Micro Systems, Haslemeres, England) within 5 min after cooking. A set of five strands of cooked noodles was placed parallel on a flat metal plate compressed crosswise twice to 70% of their original height, using the 1.5 mm metal blade at a speed of 1.0 mm/s. From force–time curves of the TPA, hardness, adhesiveness, springiness, cohesiveness,