



A Modified Method for the Preparation of *Sukati Mas* (A Traditional Fish Powder of North-east India) from *Muwa* (*Amblypharyngodon mola*)

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Abstract

Traditional method of *sukati mas* preparation was documented by conducting a study in Majuli (the biggest river island of the river Brahmaputra, Assam). *Sukati mas* was prepared by modified method (SM) using single fish *muwa* (*Amblypharyngodon mola*). The biochemical properties of SM were investigated and compared with the product prepared by traditional method (ST). Mean values of different parameters of ST and SM differed significantly ($p < 0.05$) except pH. ST and SM contained moisture 3.45 and 2.34, protein 69.83 and 77.19, lipids 4.04 and 1.13, ash 20.65 and 17.82, salt 2.12 and 1.32% respectively. Similarly they contained minerals including Ca 1543 and 3469, P 1811 and 3318, Fe 4.62 and 7.23, Na 77.6 and 122.5, K 624 and 777 mg%, respectively. Average pH was 7.23 in ST and 7.07 in SM. During 5 months storage, moisture, protein, lipids, ash, pH, TVBN and PV values in ST changed significantly ($p < 0.05$), except salt content. Similarly in SM, all these parameters except protein and ash content, changed significantly ($p < 0.05$). While the spoilage indices including TBV-N and PV increased significantly ($p < 0.05$), their values remained within the acceptable limits in both the products. Based on sensory analysis, the panel of 10 judges preferred SM in terms of aesthetic appearance, smell, flavour and taste and the scores significantly differed ($p < 0.05$) from the scores of ST

after one month of storage. The results of biochemical and sensory analysis suggested that *sukati mas* prepared from single species (SM) has better prospects to be used as a good protein supplement in human diets.

Keywords: Fish powder, North-east India, shelf life, *sukati mas*, traditional fish product

Introduction

Fish protein is suitable for development of protein based products as it contains very less stroma protein compared to mammalian meat. Such proteins naturally can serve as a convenient raw material for processing and developing diversified products including various value added products. Such advantages with fish meat enabled to develop hundreds of traditional fish products. Obviously in the same line, *sukati mas* (indigenous crude fish powder) was developed in ancient times by the fish consuming population of Upper Assam, in the bank of the river Brahmaputra. In Assam, local trash fishes are available in plenty along with other high valued fish during post-monsoon period. These small fish, being highly perishable and of low cost, have to be processed almost by compulsion by the fishers eventually for the use in the lean seasons (pre-monsoon and monsoon). The North-eastern region of India is a treasure of indigenous knowledge systems pertaining to agriculture, food, medicine, and natural resources management (Jeyaram et al., 2009). In recent years a number of traditional foods and food products prepared by different tribes/communities of the North-east region have been reported (Thapa et al., 2004; Dutta et al., 2005; Murugkar & Subbulakshmi, 2006; Mao & Odyuo, 2007; Singh et al., 2007; Jeyaram et al., 2009; Choudhry et al., 2011; Mahanta & Muzaddadi, 2012; Muzaddadi & Basu, 2012a, 2012b).

Received 11 April 2013; Revised 22 October 2013; Accepted 04 February 2014

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Different value added products prepared from freshwater fishes and their process standardization have been reported by several researchers (Chattopadhyaya et al., 1985, 1986; Khasim et al., 2005; Joseph, 2002 & 2003). There are substantially good amount of reports on the production of edible fish powder (Gopakumar, 1997; Nair, 2003; CIFT, 2006). However, *sukati mas* being an indigenous product, has not yet been scientifically explored. Therefore, the present study was conducted to evaluate the biochemical and storage properties of *sukati mas* traditionally prepared and by modified and standardized method with a single fish species (*Amblypharyngodon mola*). The purpose of the study was to optimize the biochemical and sensory characteristics of *sukati mas* which are otherwise highly variable due to the use of inconsistent varieties of fish species as raw material in traditionally prepared *sukati mas*.

Materials and Methods

A survey was conducted in Majuli, the biggest river island of Brahmaputra, in Assam. To document the traditional method of *sukati mas* preparation, 20 traditional producers and 20 production centers were randomly selected from the island. The producers were interviewed and the methods described were recorded. Further, the production centers were visited and method of product preparation was practically learned. The traditional method (Fig. 1) was summarized by deleting minor variations. The method was simplified and modified in laboratory conditions on trial and error basis. *Sukati mas* was prepared from fish *Amblypharyngodon mola* locally called as *muwa* by modified method (SM) (Fig. 2). Fresh *muwa* was collected from Maskhowa fish market, Guwahati.

People prepare *sukati mas* using a wide variety of trash fish in Majuli and they prefer to use mixture of fish species such as small carplets and barbs as raw material. Fresh fish are dressed and washed properly in pond or river water. Clean fishes are given a salt dip for one hour in saturated brine. After removing from brine, fish are exposed to sunlight for about half an hour and smoked subsequently on a bamboo sieve over wooden fire. Positions of the fishes are altered in every 4 h. Smoked fishes are ground with a wooden grinder to make fish powder and stored in glass bottles at room temperature.

The laboratory prepared product was packed in HDPE (transparent) sachets of 200 μ gauge in 100 g quantities. Freshly prepared traditional product was procured from Majuli and similarly packed. Both the products were stored at room temperature ($32\pm3^{\circ}\text{C}$, Relative Humidity $78\pm5\%$) and monthly sampling was carried out for all the biochemical and sensory evaluation. Proximate moisture, protein, fat and ash contents were done by AOAC (2000). Crude fat content was determined by Soxhlet method (AOAC, 2000). The levels of Ca, Na, K, Fe and Mg were determined in all the samples by atomic absorption spectrometry as described by Jorhem (2000). Phosphorus was determined spectrophotometrically according to ISO Standard 13730 (1996).

Total volatile base nitrogen was estimated by Conway micro diffusion method (Conway, 1974) and peroxide value as per Jacob (1958). The pH of edible fish powder was measured in a slurry made with distilled water (1:10) using digital pH meter (AOAC, 2000).

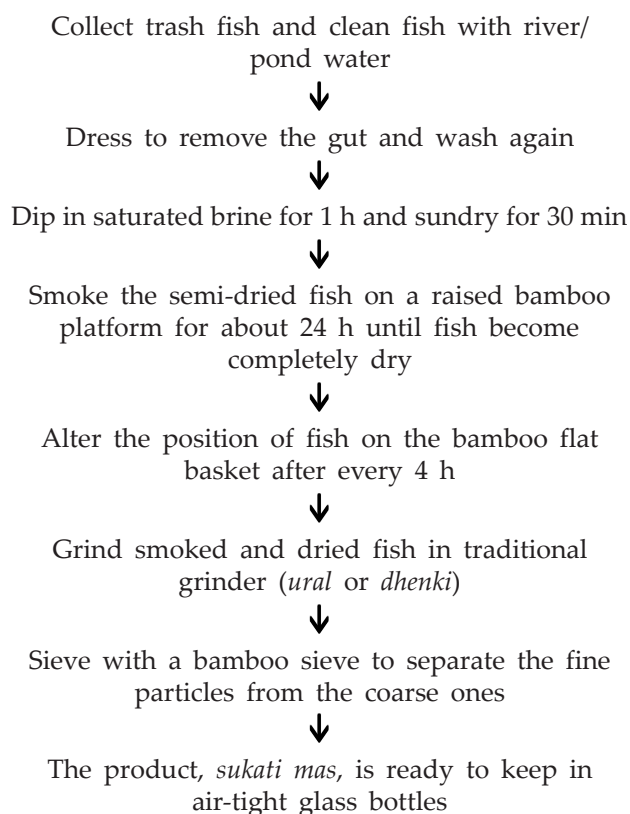


Fig. 1. The traditional method (ST) of *sukati mas* preparation

The sensory analysis was conducted by a panel of 10 judges (drawn from regular *sukati mas* consumers). Vegetable curry incorporated with 10% *sukati mas* was prepared for monthly sampling. Similarly separate curries were prepared with fresh fish powder and stored fish powder for each monthly sampling. Identical bowls were used for each treated batches. Panel members (n=10) were asked to judge the intensity of the fish flavour and taste and give the overall acceptability score on a 9 point Hedonic scale (Joseph, 2003), and the product was considered unacceptable if score was below 5.

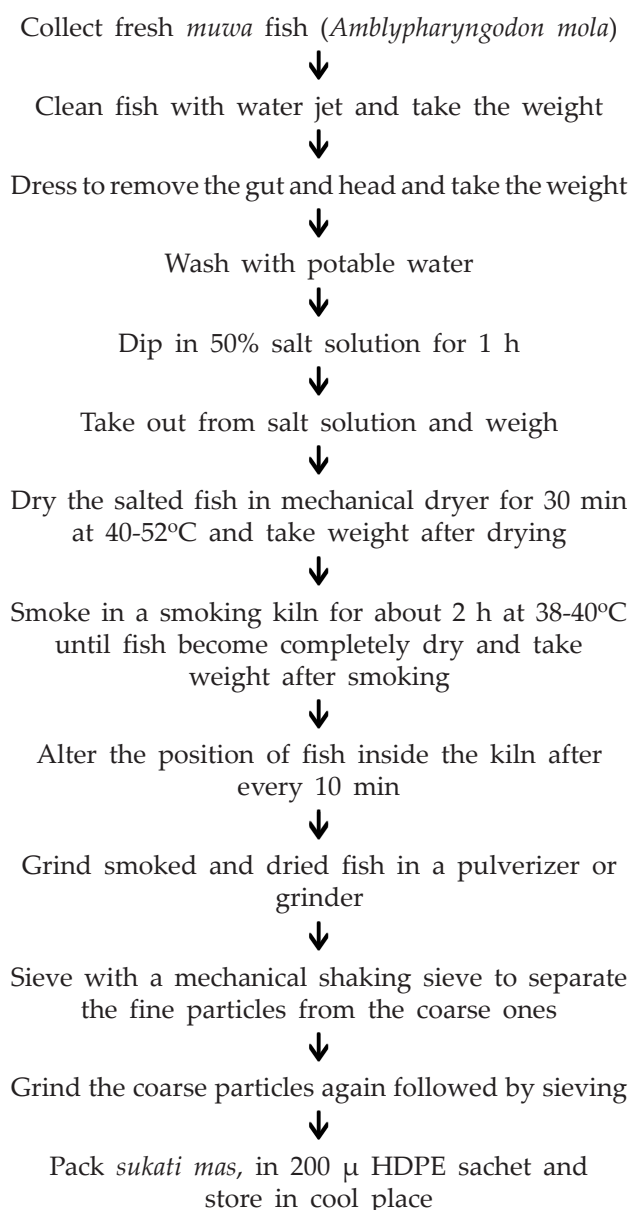


Fig. 2. Standardised method (SM) for *sukati mas* preparation

Statistical analysis was done using SPSS (Version 16.0) and the significance of the difference between means was determined using Duncan's multiple range test (DMRT). One-way ANOVA was applied to determine significant effect with respect to storage period. The data were expressed by mean $\pm$ SE and differences were considered significant at $p < 0.05$. Independent samples t test was performed to compare the means of different nutrients of traditionally prepared *sukati mas* (ST) and *sukati mas* prepared by modified method (SM).

Results and Discussion

Three curing methods including salting, drying and smoking were used in sequence for the product preparation. Thus, the product perhaps, would possess some of the advantages of all these three methods. Salting decreases bacterial load, water activity and improve drying rate (Jason & Peters, 1983). Further, the microbial spoilage by halophilic bacteria due to higher concentration of salt (about 4%) is unlikely, since such bacteria would grow when salt concentration is more than 10% (Horner, 1997). Another reason of less probability of microbial growth is the antimicrobial properties of the phenolic and formaldehyde constituents of smoke (Incze, 1965). The phenolic components also contribute to smoky flavour (Gilber & Knowles, 1975) and antioxidative activity (Kurko, 1966).

The standardized method (Fig. 2) consisted of 13 steps which was an adaptation to the defined laboratory condition. In the present study, the major change was to restrict the raw material to a single species of fish (*Amblypharyngodon mola*) rather than using a mixture of species with an objective to have a consistent quality in the end product. Pires et al. (2012) attempted to prepare protein powder from Cape hake (*Merluccius capensis*) by-products for similar reasons. *Shidal* (fermented fish product of Northeast India) was prepared from a single carplet (*Puntius* spp.) to get uniform quality for the product (Muzaddadi & Basu, 2012a, b; Mahanta & Muzaddadi, 2012). The head of the fish was excluded in the standard method since the head, being very small in size, did not contribute much to the bulk yield; rather its inclusion gave an unattractive colour to the product.

A. mola was selected from 11 commonly used species (Table 1) for preparation of experimental *sukati mas* (SM) due to several reasons such as [1]

Table 1. Small trash fish used as raw material in traditionally prepared *Sukati mas*.

English name	Scientific name	Common /Local name	Normal size range (cm)
Dwarf gourami	<i>Colisa lalius</i> (Hamilton, 1822)	<i>Kholihona</i>	5-8
Flying barb	<i>Esomus danricus</i> (Hamilton, 1822)	<i>Dorikona</i>	3-10
Gangetic scissortail rasbora	<i>Rasbora rasbora</i> (Hamilton, 1822)	<i>Dorikona</i>	5-10
Indian hatchet chela	<i>Chela cachius</i> (Hamilton, 1822)	<i>Chelekona</i>	3-6
Mola carplet	<i>Amblypharyngodon mola</i> (Hamilton, 1822)	<i>Muwa</i>	2-5
Olive barb	<i>Puntius sarana</i> (Valenciennes, 1842)	<i>Cheni puthi</i>	3-8
Pool barb	<i>Puntius sophore</i> (McClelland, 1839)	<i>Soru puthi</i>	3-6
Slender rasbora	<i>Rasbora daniconius</i> (Hamilton, 1822)	<i>Dorikona</i>	3-10
Swamp barb	<i>Puntius chola</i> (Hamilton, 1822)	<i>Doloni puthi</i>	2-5
Two spot barb	<i>Pethia ticto</i> (Hamilton, 1822)	<i>Tita puthi</i>	3-8
Zebra danio	<i>Danio rerio</i> (Hamilton, 1822)	<i>Dorikona</i>	1-5

its fine bones get crushed to powder easily, [2] its whitish meat gives attractive colour to the end product, [3] its natural smell is less pungent than that of other species, resulting in less pungent end product, [4] its fat content is comparatively less that ensures less rancidity (Table 2), [5] it is available in plenty in uniform size-range during post monsoon that ensures stable biochemical characteristics of *sukati mas*.

The proximate composition and mineral contents of *A. mola* are given in Table 2. The raw fish contained high moisture (18.4%) and protein (71%), while it contained very less lipids (1.2%) and ash (9.2%). This signifies the suitability of *A. mola* as a raw material for preparation of protein powder. Less lipid content reduced the problem of rancidity and less mineral content increased the purity of protein in the product. However, the mineral contents including Ca, P, Fe, Na and K are important as supplement in the products.

A significant difference ($p < 0.05$) was observed in the proximate composition of traditional *sukati mas* (ST) and freshly prepared *sukati mas* from *A. mola* (SM) (Table 2). Both the products (ST and SM) contained high protein level, 69.83 and 77.19, and low lipid level, 4.04 and 1.13%, respectively. Average moisture content was 3.45% in ST and 2.34% in SM. High protein content, low lipid level and moisture content were also reported by Sathivel et al. (2005) and Pires et al. (2012) in fish protein powder.

ST and SM contained moderately high amount of minerals including Ca 1543 and 3469, P 1811, 3318 k 624 and 777 mg%, respectively. The high mineral content in the product may be due to the inclusion of bones in the final product. Even though the separation of bones from the usable meat is a major problem in preparing other convenient fish products, this difficulty has been tackled in the production of *sukati mas* by allowing the bones to be a component of the product which makes the product richer in mineral contents. Fish protein powder prepared from Cape hack by-products was rich in mineral contents (Pires et al., 2012).

Table 2. Proximate composition and mineral content of *muwa* (*Amblypharyngodon mola*) fish (mean $\pm$ SE, n=3)

Parameters	<i>Muwa</i>
Moisture (%)	71.0 $\pm$ 0.3
Protein, %	18.4 $\pm$ 0.7
Lipids, %	1.2 $\pm$ 0.2
Ash, %	9.2 $\pm$ 0.8
Calcium, mg%	130.0 $\pm$ 23
Phosphorous, mg %	349.0 $\pm$ 31
Iron, mg%	1.54 $\pm$ 0.3
Sodium, mg %	10.34 $\pm$ 1.5
Potassium, mg %	271.0 $\pm$ 28

During storage, significant ($p < 0.05$) variations were noticed in moisture, protein, lipid, and calcium except phosphorous ($p > 0.05$) (Table 4 and 5). While the spoilage indices including total volatile base nitrogen (TVB-N) and peroxide value (PV) increased significantly ($p < 0.05$), their values remained within the limits. Based on sensory analysis, SM was preferred in terms of aesthetic appearance, less pungent smell, flavour and taste. The results of biochemical and sensory analysis suggested that *sukati mas* prepared from single species (SM) has

better prospects to be used as a good protein supplement in the human diets and may be commercialized with suitable packaging technology for entrepreneurs.

Biochemical changes during 5 months storage are presented in Table 4 and 5 for ST and SM respectively. In ST, moisture level, protein, lipids ash, pH, TVB-N and PV changed significantly ($p < 0.05$) except the salt content. Moisture content differed significantly ($p < 0.05$) during the five month

Table 3. Nutritional composition of *sukati mas* prepared by modified method (SM) and traditional method (ST) on dry weight basis (mean $\pm$ SE, $p < 0.05$, $n=3$)

Parameters	ST	SM	P-Value
Moisture, %	3.45 $\pm$ 0.06	2.34 $\pm$ 0.04	<0.001
Protein, %	69.83 $\pm$ 0.64	77.19 $\pm$ 0.69	0.001
Lipids, %	4.04 $\pm$ 0.12	1.13 $\pm$ 0.04	<0.001
Ash, %	20.65 $\pm$ 0.32	17.82 $\pm$ 0.24	0.002
Salt, %	2.12 $\pm$ 0.05	1.32 $\pm$ 0.05	<0.001
Calcium, mg%	1543 $\pm$ 33	3469 $\pm$ 73	<0.001
Phosphorous, mg%	1811 $\pm$ 40	3318 $\pm$ 49	<0.001
Iron, mg%	4.62 $\pm$ 0.10	7.23 $\pm$ 0.11	<0.001
Sodium, mg %	77.6 $\pm$ 0.32	122.5 $\pm$ 5.5	0.001
Potassium, mg %	624 $\pm$ 14	777 $\pm$ 25	0.006
pH	7.23 $\pm$ 0.07	7.07 $\pm$ 0.15	0.356

Table 4. Changes in proximate composition during storage of traditional *sukati mas* (ST)

Parameters	Storage period in days						p-value
	0	30	60	90	120	150	
Moisture (%)	3.45 ^a $\pm$ 0.06	4.75 ^b $\pm$ 0.12	5.35 ^b $\pm$ 0.46	5.39 ^b $\pm$ 0.28	6.83 ^c $\pm$ 0.42	8.54 ^d $\pm$ 0.36	<0.001
Protein, %	69.83 ^{bc} $\pm$ 0.64	70.50 ^c $\pm$ 1.07	68.29 ^{ab} $\pm$ 0.38	67.36 ^a $\pm$ 0.52	66.79 ^a $\pm$ 0.20	67.01 ^a $\pm$ 0.69	0.006
Lipids, %	4.04 ^c $\pm$ 0.12	3.57 ^b $\pm$ 0.09	3.58 ^b $\pm$ 0.03	3.44 ^b $\pm$ 0.09	3.17 ^a $\pm$ 0.03	3.16 ^a $\pm$ 0.01	<0.001
Ash, %	20.65 ^c $\pm$ 0.32	19.44 ^{ab} $\pm$ 0.41	19.40 ^{ab} $\pm$ 0.46	19.60 ^{abc} $\pm$ 0.22	19.78 ^{bc} $\pm$ 0.24	18.58 ^a $\pm$ 0.30	0.022
Salt, %	2.12 $\pm$ 0.05	2.23 $\pm$ 0.05	1.96 $\pm$ 0.04	2.09 $\pm$ 0.10	2.32 $\pm$ 0.24	2.00 $\pm$ 0.12	0.285*
pH	7.23 ^a $\pm$ 0.07	7.37 ^{ab} $\pm$ 0.09	7.50 ^b $\pm$ 0.06	7.53 ^b $\pm$ 0.09	7.80 ^c $\pm$ 0.06	7.8 ^c $\pm$ 0.06	<0.001
TVBN, mg%	24.50 ^a $\pm$ 1.02	42.14 ^b $\pm$ 1.21	50.22 ^c $\pm$ 1.51	57.34 ^d $\pm$ 1.62	59.80 ^d $\pm$ 1.07	60.60 ^d $\pm$ 1.46	<0.001
PV, meq of O ₂ kg ⁻¹ of fat	9.24 ^a $\pm$ 0.12	10.32 ^{ab} $\pm$ 0.36	11.35 ^{bc} $\pm$ 0.37	12.48 ^{cd} $\pm$ 0.56	13.62 ^{de} $\pm$ 0.32	14.00 ^e $\pm$ 0.72	<0.001

Means identified by different superscripts (a, b, c, d & e) in the row are significantly different ($p < 0.05$) for each parameter analysed

Values are mean $\pm$ S.E. ($n=3$)

*Change insignificantly $p > 0.05$

storage, lowest being at 0 days (3.45%) and increased to 8.54% which may be due to the absorption from the humid atmosphere, as the average relative humidity of the atmosphere remained more than 95% during production period. Crude protein level slightly reduced from 69.83 to 67% at the end of the storage period. The lipid and ash content reduced towards the end of the storage period, while salt content did not change significantly ($p>0.05$). Total volatile base nitrogen values increased from 24.50 mg% on 0 day to 60.6 mg% on 150 days storage and this value is within the limit of 100-200 mg% for salted and dried fish (Gopakumar, 2002). Similarly, peroxide value was comparatively low on 0 days (9.24) and increased slowly and reached to 14.0 mg% on 150 days of

storage which indicates lower rancidity level of fats. pH turned to be slightly alkaline towards the end of the storage period which may be due to the production of nitrogenous bases. The moisture level increased significantly, but remained less than 5% after fifth month of storage. Protein and ash content did not differ significantly ($p>0.05$) during whole storage period, while all other parameters changed significantly. Interestingly, all these parameters had much lower values than that of ST, except protein and pH. Though pH changed significantly, the value remained similar in both the products. Since ST was produced from a mixed varieties of fish species, its biochemical properties were unpredictable which in turn would limit the possibilities of refining the product. On the other hand, the less moisture,

Table 5. Changes in proximate composition during storage period of *sukati mas* prepared by modified method using *A. mola*

Parameters	Storage period in days						P-Value
	0	30	60	90	120	150	
Moisture, %	2.34 ^a ± 0.04	2.96 ^{ab} ± 0.26	3.43 ^{bc} ± 0.21	3.71 ^{cd} ± 0.22	3.87 ^{cd} ± 0.17	4.24 ^d ± 0.30	0.001
Protein, %	77.19 ± 0.69	76.55 ± 0.32	76.57 ± 0.39	75.81 ± 0.46	76.33 ± 0.31	75.24 ± 0.37	0.105*
Lipids, %	1.13 ^d ± 0.05	1.08 ^{cd} ± 0.02	1.01 ^{bc} ± 0.02	0.91 ^{ab} ± 0.03	0.90 ^a ± 0.04	0.86 ^a ± 0.03	<0.001
Ash, %	17.82 ± 0.24	17.19 ± 0.21	16.95 ± 0.37	17.78 ± 0.29	16.97 ± 0.33	17.17 ± 0.31	0.201*
Salt, %	1.32 ^d ± 0.05	1.22 ^c ± 0.02	1.14 ^{bc} ± 0.01	1.07 ^{ab} ± 0.01	1.06 ^{ab} ± 0.03	1.01 ^a ± 0.02	<0.001
pH	7.07 ^a ± 0.15	7.30 ^{ab} ± 0.06	7.47 ^{bc} ± 0.03	7.70 ^{cd} ± 0.06	7.77 ^d ± 0.07	7.80 ^d ± 0.06	<0.001
TVBN, mg%	16.23 ^a ± 0.38	22.68 ^b ± 0.35	29.26 ^c ± 0.80	37.46 ^d ± 0.67	42.64 ^e ± 0.61	44.17 ^e ± 1.01	<0.001
PV, meq of O ₂ kg ⁻¹ of Fat	6.61 ^a ± 0.15	6.98 ^a ± 0.21	8.05 ^b ± 0.30	8.57 ^{bc} ± 0.15	8.84 ^c ± 0.16	9.10 ^c ± 0.27	<0.001

Means identified by different superscripts (a, b, c, d & e) in the row are significantly different ($p<0.05$) for each parameter analysed. Values are mean ± S.E. (n=3)

*Change insignificantly $p>0.05$

Table 6. Overall sensory scores (9 point Hedonic scale) of vegetable curry incorporated with traditional *sukati mas* (ST) and *sukati mas* prepared by modified method (SM) during different storage intervals (mean ± SE, independent sampled *t*-test, $p<0.05$, n=10)

Storage period (Days)	SM	ST	p-value
0	8.85 ± 0.14	8.72 ± 0.22	0.06
30	8.71 ± 0.26	8.68 ± 0.32	0.08
60	8.66 ± 0.28	8.38 ± 0.49	0.04
90	8.59 ± 0.38	7.85 ± 0.61	0.02
120	8.32 ± 0.35	7.44 ± 0.76	0.005
150	8.10 ± 0.17	7.00 ± 0.80	0.004

lipids, TVB-N and PV values of SM apparently provided good storage stability to the product and better scope of product standardization.

Organoleptic scores of fish powder during storage are given in Table 6. Flavour and taste scores were higher in fresh *sukati mas* and tend to decrease with the increase in storage period. Panel members were satisfied with the flavour and taste of the fish powder even after 5 months storage. No significant changes ($p>0.05$) observed for the values of vegetable curry with fresh *sukati mas*. In contrast, the values for vegetable curry prepared with *sukati mas* stored for 1 month, changed significantly ($p<0.05$). Highest value was recorded on 0 day (8.85 ± 0.01) and lowest on 150 days (7.00 ± 0.80). However, this product was acceptable even after 5 months of storage.

This new method of *sukati mas* preparation incorporating hygienic steps, mechanical drying and grinding for speeding up the process and stable biochemical and sensory properties of the product, have better scope of commercialization. Traditional method of *sukati mas* preparation is a crude method of fish powder or protein powder preparation.

Sukati mas, an already preferred product by a wide segment of fish eating population of Assam can be easily commercialized at least in the Northeastern states of India after few more studies especially on further refinement and packaging aspects. Result of the present study are expected to provide some basic information about this almost unknown product for further studies.

Acknowledgements

The authors are highly thankful to the fisher folks in Majuli, Assam for providing training and valuable information on the product. The authors also thank the authorities of Gauhati University and College of Fisheries, Central Agricultural University, Tripura for providing laboratory facilities to conduct the research.

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