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Physico-Chemical Characteristics of Sapota (Chikoo) Powder based Value Added Pasta Product using Semolina (Suji) and Maida

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ABSTRACT

The cereals of today are more nutritious and healthful than ever before. Cereals processing is one of the oldest and the most essential part of all food technologies. Pasta products and noodles have been staple foods since ancient times in many countries all over the world. In this study pasta formulation was substituted with blending sapota powder in different proportions (4 levels i.e. 0%, 10%, 20%, 30%) into semolina and maida flour separately. Pasta products were prepared using eight different formulations and adding water (approximately 31% of total weight) in DOLLY pasta extruder machine. All the samples were evaluated for physical properties: specific length (mm/g), bulk density (kg/m^3), specific density (kg/m^3) and porosity (%); functional properties: water absorption index (%), water solubility index (%) and oil absorption capacity (ml/g) and nutritional compositions: moisture (%), crude protein (%), fat (%) and carbohydrate (%). Highest specific length 36.20 mm/g was observed for T_5 treatment, low bulk density 368.10 kg/m^3 was observed for T_5 and highest porosity 9.24% was found for T_1 treatment. The maximum WAI, WSI values 325.83%, 17.33% respectively was observed for T_1 treatment and minimum value of oil absorption capacity 1.06 ml/g for T_8 treatment. The moisture content of dried pasta products was found in the range of 6 to 7%. The maximum value of crude protein 13.07% was found for T_5 and minimum value 8.81% for T_4 treatments. The fat contents were varied from 1.02 to 1.28 %. The maximum value of carbohydrate was 76.20% for T_1 and minimum value 65.41% for T_8.

KEYWORDS

Pasta, sapota (*chikoo*) powder, physico-chemical characteristics, semolina (*suji*), value added product

INTRODUCTION

In the past years, the consumers demand for nutritional diets rich in compounds with functional properties has been increasing. One way to increase nutritional properties of foods is the incorporation of functional ingredients in staple foods. Pasta products are the most ancient source of food consumed from wheat. Pasta's versatility, long shelf life, availability in numerous shapes and sizes, good nutrition, and relatively low cost are attractive to the consumer. Pasta products are becoming popular in current lifestyle because they are healthy, tasty and convenient for transportation and preparation (Cubadda, 1994). In addition, the consumption of pasta has been increasing among consumers due to rapid urbanization and globalization. Nutritionists consider pasta to be highly digestible, providing significant quantities of complex carbohydrates, low sodium and total fat (Douglass *et al.*, 1982). However, it is low in dietary fibers, minerals and essential fatty acids according to researchers (Prabhasankar *et al.*, 2009).

Breakfast cereals play an important role in the diet and ensure the proper organism functioning e.g. nervous system and gastrointestinal tract. Among cereals, only wheat is usually considered suitable for pasta manufacture. This is because their proteins have the properties required for interaction between themselves and with other components, mainly lipids, to form a very specific viscoelastic lipoprotein complex called gluten when flour (or semolina) and water are mixed together. Pasta made from durum semolina maintains a desirable firm texture during cooking, and it has a natural amber colour that is associated with good quality pasta (Kaur *et al.*, 2012). Pasta products, traditionally manufactured from durum wheat semolina, known to be the best raw material suitable for pasta production (Feilet and Dexter, 1998; Marchylo and Dexter, 2001).

Sapota or chikoo [*Manilkara zapota* (L.) Royen] is a tropical fruit, which is a native of American continent, but it is largely grown in India and Mexico. The ripened sapota fruit is a good source of sugar which ranges between 12 and 14%. A 100 g of edible portion of fruit contains moisture (73.7 g), carbohydrates (21.49 g), protein (0.7 g), fat (1.1 g), calcium (28 mg), phosphorus (27 mg), Iron (2 mg) and ascorbic acid (6 mg) (Bose and Mitra, 1990). The chikoo fruit contributes to overall health and wellness of the body because it is packed with many nutrients. Chikoo is high in calories and so, it falls in the category of fruits such as mango, banana and jack fruit. Sapota or chikoo powder will be utilized to improve the nutritional quality of developed pasta products. The semolina and maida were separately mixed with sapota powder in different ratios and pasta products will be developed by using the pasta machine (*Imperia & Monferrina-Dolly*). Packaging of extruded products is necessary to prevent contamination and damage during transport and storage. It provides clarity as well as protection against insect and moisture. Low density polyethylene (HDPE) bags 200-micron thickness was used for packaging of pasta products (Ranganna *et al.*, 2014). In the present study, an attempt was made to develop sapota (*chikoo*) powder-based value-added pasta product using semolina (*suji*) and maida. The aim of the study was the evaluation of effect of blending of sapota (*chikoo*) powder in different proportion into semolina (*suji*) and maida flour separately on physico-chemical properties of pasta products.

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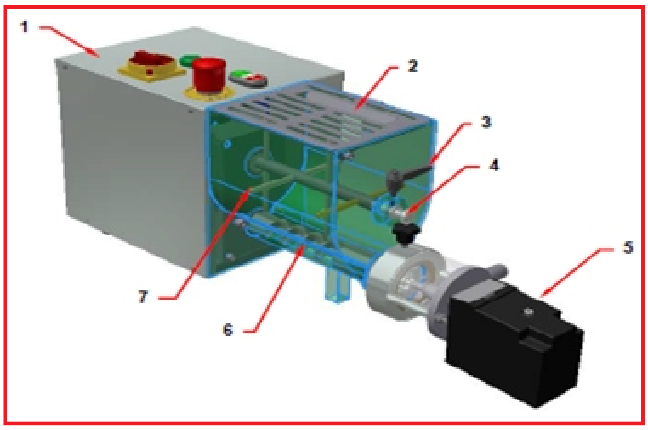
MATERIALS AND METHODS

Experiment was conducted at Department of Processing & Food Engineering (PFE), College of Agricultural Engineering & Technology, NAU, Dediapada, Narmada District, Gujarat. Raw materials commercial durum wheat semolina (*suji*), maida and sapota (*chikoo*) fruits were purchased from local market of Dediapada. Ripened sapota of uniform size, colour and firm texture were taken and washed under tap water to remove adhering impurities before slicing the fruit. The outer skin of the ripened fruit was carefully peeled off manually using a sharp stainless-steel knife without damaging the pulp. The peeled sapota fruits were cut into about 4-5 mm thick slices and dried into tray dryer. The sapota powder was prepared from dried sapota pulp with the help of mixture machine. After that the pasta products were prepared in DOLLY pasta extruder machine (Fig. 1) by blending sapota powder in different proportions (4 level i.e. 0%, 10%, 20%, 30%) into semolina and maida flour separately followed by adding water (approx. 31% of total weight) and mixed. Pasta can be dried in the hot air oven at 50 °C to attain moisture content approx 6 ± 1%. Rigatoni shape die was used for pasta products preparations. Total eight different types of pasta products with three replications were prepared dried and packed in 200-micron HDPE bags (Fig. 2 a & b) for further analysis as under:

T_1: 100 % Maida
T_2: 90 % Maida + 10 % sapota (*chikoo*) powder
T_3: 80 % Maida + 20 % sapota (*chikoo*) powder
T_4: 70 % Maida + 30 % sapota (*chikoo*) powder
T_5: 100 % Semolina (*suji*)
T_6: 90 % Semolina (*suji*) + 10 % sapota (*chikoo*) powder
T_7: 80 % Semolina (*suji*) + 20 % sapota (*chikoo*) powder
T_8: 70 % Semolina (*suji*) + 30 % sapota (*chikoo*) powder

Physical properties: Specific length (mm/g), Bulk density (kg/m^3), specific density (kg/m^3) and porosity (%). Functional properties: Water absorption index (%), water solubility index (%) and oil absorption capacity (ml/g). Nutritional compositions: Moisture (%), Crude Protein (%), Fat (%) and Carbohydrate (%)



1. Control panel
2. Safety cover
3. Mixer shaft clamp/release lever
4. Pin
5. Dough-cutter motor
6. Feeder
7. Mixer shaft

Fig. 1: DOLLY Pasta Extruder Machine

Bulk density and specific density of the products was tested in five replications according to ASAE Standard (ASAE S269.3:1989) as mass of the sample volume (kgm^{-3}). The oil absorption capacities were determined as described by Onimawo and Akubor (2012). Water absorption index (WAI) and water solubility index (WSI) were determined according to Mitrus *et al.* (2010). The nutritional components of the pasta products were analyzed according to AOAC Method (1980). All the experiments were conducted in triplicates in completely randomized design (CRD) for statistical analysis of the pasta products. Significance was accepted at $p<0.05$.

<u>Process Flow Chart for the Preparation of Pasta from Maida or Semolina (*suji*) Blended with Sapota (*Chikoo*) Powder</u>

Semolina (suji) / maida powder
↓
Sapota (*chikoo*) powder blended with different proportions (0 %, 10%, 20 % and 30 %) separately
↓
Mixed material to be kept in the mixing chamber of pasta extruder for homogenous mixing with the help of mixer shaft
↓
Addition of water (31 % of total weight) slowly in the mixing chamber and again mixing for 10 minute to distribute water uniformly throughout the flour particles
↓
Moist flour aggregate passed through the feeder in a metal extruder machine fitted with die and adjustable cutter for cutting pasta products in desirable length
↓
Developed pasta products were dried in the hot air oven at 50 °C for to attain moisture content approx 6 ± 1 %
↓
Dried pasta packed HDPE bags of 200-micron thickness
↓
Sealing
↓
Labeling
↓
Storage

Fig. 2 (a): Different types of pasta made by sapota powder blended with maida

RESULTS AND DISCUSSION

The experiment was conducted as per treatments and the detail of the process flow chart described as above. The analysis of the various parameters was carried out as per the standard methods. The details of results of the experiments were presented here under.

Physical Properties

The effects of various treatments on physical properties are presented in Table 1. From this Table 1 it can be seen that there was significant variation on specific length, specific density, bulk density and porosity for all treatments. It may be due to blending of sapota powder in different proportions into semolina and maida flour. Specific length is a quality parameter to know the longitudinal expansion of pasta, which shows that maximum length in per unit mass is desirable for better product quality. Highest specific length 36.20 mm/g was observed for T_5

Fig. 2 (b): Different types of pasta made by sapota powder blended with semolina (suji

treatment followed by T_2 and T_6. Low bulk density suggests good porosity and aeration of pasta structure, which is desirable mainly in snack foods (Mościcki *et al.*, 2007; Wójtowicz *et al.*, 2013). Low bulk density 368.10 kg/m^3 was observed for T_5 followed T_6, T_1 and T_7. Highest porosity

9.24 % was found for T_1 treatment followed T_6, T_2 and T_5. Thus, as the amount of sapota powder increases in the pasta samples, the bulk density of the extruded product increases. This may be attributed to the higher bulk density value of sapota powder than wheat flour. The bulk density of a good material is important in relation to its packaging. Bulk density is generally affected by the particle size and density of the flour (Karuna *et al*., 1996).

Functional Properties

The effects of various treatments on physical properties are presented in Table 2. The water absorption index (WAI) is the measure of the volume occupied by the pasta starch after swelling in excess water, which maintains the integrity of starch in aqueous dispersion, which can be used as an index of gelatinization. From this Table 2 it can be seen that there was significant variation on water absorption index (WAI), water solubility index (WSI) and oil absorption capacity (ml/g) for all treatments. The maximum WAI, WSI values 325.83 %, 17.33 %, respectively was observed for T_1 treatment and minimum value of oil absorption capacity 1.06 ml/g for T_8 treatment

Table 1: Effect of treatments on physical properties of pasta products

Treatments	Specific length (mm/g)			Specific Density (kg/m³)			Bulk Density (kg/m³)			Porosity (%)		
	Y_1	Y_2	P	Y_1	Y_2	P	Y_1	Y_2	P	Y_1	Y_2	P
T_1	34.42	34.58	34.50	427.43	427.97	427.70	387.35	388.99	388.17	9.38	9.11	9.24
T_2	34.98	34.96	34.97	463.87	463.11	463.49	423.24	423.99	423.62	8.76	8.44	8.60
T_3	34.30	34.46	34.38	479.39	480.80	480.10	439.82	439.78	439.80	8.25	8.53	8.39
T_4	34.15	34.17	34.16	491.51	490.45	490.98	452.57	452.19	452.38	7.92	7.80	7.86
T_5	36.15	36.25	36.20	403.40	402.91	403.15	368.12	368.07	368.10	8.74	8.64	8.69
T_6	34.98	35.22	35.10	408.82	410.77	409.80	373.52	373.62	373.57	8.63	9.03	8.83
T_7	34.77	34.96	34.87	430.86	433.04	431.95	394.89	395.02	394.95	8.35	8.78	8.56
T_8	34.19	34.22	34.21	437.67	439.50	438.58	401.77	402.18	401.98	8.20	8.49	8.35
Mean	34.74	34.85	34.80	442.87	443.57	443.22	405.16	405.48	405.32	8.53	8.60	8.57
S.Em ±	0.093	0.200	0.102	2.394	3.043	1.776	1.893	2.035	1.266	0.198	0.366	0.200
CD at 5 %	0.279	0.599	0.291	2.178	9.122	5.080	5.676	6.100	3.622	0.594	NS	0.571
CV %	0.46	0.99	0.78	0.94	1.19	1.07	0.81	0.87	0.84	4.03	7.38	5.96
Y x T												
S.Em ±			0.156			2.738			1.966			0.295
CD at 5 %			NS			NS			NS			NS
	Y_1 = 1st lot			Y_2 = 2nd lot			T = Treatments			P = Pooled		

Table 2: Effect of treatments on functional properties of pasta products

Treatments	WAI (%)			WSI (%)			Oil absorption capacity (ml/g)		
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
T_1	325.67	326.00	325.83	17.33	17.33	17.33	1.70	1.71	1.70
T_2	313.33	313.33	313.33	13.67	14.33	14.00	1.55	1.57	1.56
T_3	296.67	299.67	298.17	12.67	12.00	12.33	1.41	1.41	1.41
T_4	288.67	289.00	288.83	9.33	10.33	9.83	1.16	1.16	1.16
T_5	316.67	317.33	317.00	13.00	14.00	13.50	1.55	1.56	1.56
T_6	289.67	294.33	292.00	11.33	12.00	11.67	1.34	1.34	1.34
T_7	274.00	274.33	274.17	10.00	9.33	9.67	1.13	1.13	1.13
T_8	251.33	252.00	251.67	8.33	8.33	8.33	1.06	1.05	1.06
Mean	294.50	295.75	295.13	11.96	12.21	12.08	1.36	1.37	1.36
S.Em ±	2.35	1.439	1.299	0.500	0.697	0.414	0.013	0.011	0.008
CD at 5 %	7.067	4.313	3.718	1.499	2.09	1.187	0.040	0.033	0.023
CV %	1.39	0.84	1.15	7.24	9.89	8.70	1.69	1.39	1.54
Y x T									
S.Em ±			1.953			0.607			0.012
CD at 5 %			NS			NS			NS
		Y_1 = 1st lot		Y_2 = 2nd lot		P = Pooled			

followed by T_7, T_4 and T_6. The lowest amount of WAI, WSI reported for the treatments T_4 and T_8 it may be due to low carbohydrate content. WAI, an indicator of the ability of pasta products to absorb water, depends on the availability of hydrophilic groups which bind water molecules and, on the gel-forming capacity of macromolecules. WSI is used as a measure for starch degradation. WSI of the pasta products was decreased with a decrease in maida and semolina (*suji*) in the blend.

Nutritional compositions

Moisture content, crude protein, fat and carbohydrate of different dried pasta products were estimated using standard procedure. Nutritional composition of the pasta products is presented in Table 3. The moisture content of dried pasta products was found in the range of 6 to 7 %. The maximum value of crude protein 13.07 % was found for T_5 and minimum value 8.81 % for T_4 treatments. The fat contents were varied from 1.02 % to 1.28 %. The maximum value of carbohydrate was 76.20 % for T_1 and minimum value 65.41 % for T_8. Thus, it was found that when blending proportion of sapota (*Chikoo*) powder were increases from 10 to 30 % into maida and semolina separately, then the value of crude protein and carbohydrate were decreases among all treatments.

Table 3: Nutritional compositions of dried pasta product

Treatments	Moisture (%)			Crude Protein (%)			Fat (%)			Carbohydrate (%)		
	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled	Y_1	Y_2	Pooled
T_1	6.60	7.00	6.80	11.65	11.78	11.72	1.28	1.28	1.28	76.30	76.10	76.20
T_2	6.90	6.70	6.80	10.71	10.68	10.70	1.27	1.27	1.27	74.13	74.03	74.08
T_3	6.90	7.10	7.00	9.72	9.69	9.71	1.26	1.25	1.26	71.56	71.67	71.62
T_4	7.30	7.00	7.15	8.86	8.76	8.81	1.25	1.25	1.25	67.19	67.10	67.15
T_5	6.40	6.60	6.50	13.15	12.98	13.07	1.02	1.02	1.02	75.38	75.42	75.40
T_6	6.80	6.70	6.75	12.84	12.57	12.71	1.04	1.03	1.04	73.47	73.43	73.45
T_7	7.00	6.90	6.95	11.50	11.48	11.49	1.06	1.05	1.06	69.56	69.94	69.75
T_8	7.20	7.00	7.10	10.77	10.52	10.65	1.07	1.07	1.07	65.38	65.44	65.41

CONCLUSION

Pasta has a universal appeal and good carrier for supplying nutrition for such a section of people who are health conscious. The results illustrate the potentiality and functionality of sapota (*chikoo*) powder-based value-added pasta products. Significant variations were observed on specific length, specific density, bulk density, porosity, water absorption index (WAI), water solubility index (WSI) and oil absorption capacity (ml/g) for all treatments.

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