

Sensory Properties and Microbial Characteristics of Cookies Prepared from Refined Wheat Flour Supplemented With Sweet Potato Flour and Whey Protein Concentrate

Abstract: A study was conducted for sensory analysis and microbial assay for the cookies supplemented with refined wheat flour, sweet potato flour and whey proteins concentrate (80%). The cookies made were nutritious products for all peoples. The product on the whole composed of sweet potato flour, whey protein concentrate (80%), refined wheat flour and other ingredients such as butter and sugar. The product was made with different formulations. Sensory evaluation was done for acceptability of the product and microbial study was conducted for the developed cookies. Results from sensory analysis revealed were shown that all treatment combinations are in acceptable level. Among all, T₃ HT1 (20% SPF and 20% WPC) scored best in overall acceptability. SPC ranges from 1.4±0.426 to 4.6±0.5477 from 0th to 30th days, Yeast and mould was NIL in 0th and 15th day on 30th it was recorded. Coli forms count is NIL in 0th day and it was recorded in 15th and 30th days for different treatment combination.

Key words: Sweet Potato Flour, Whey Protein Concentrate, Cookies Sensory Evaluation, Microbial Assay

Introduction:

The sweet potato *Ipomoea batatas* (L.) belongs to the Convolvulaceae or morning glory family (Jones, 1965). Sweet potato is among the world's most important and under-exploited crop. Sweet-potato (*Ipomoea batatas* L) is the seventh most important food crop in the world. It is grown in many tropical and subtropical regions. Among the world's major food crops, sweet-potato produces the highest amount of edible energy/ha/day (Horton and Fano, 1985). Sweet-potato flour can serve as a source of energy and nutrients (carbohydrates, beta-carotene (provitamin A), minerals (Ca, P, Fe, and K), and can add natural sweetness, color, flavor, and dietary fiber to processed food products (Woolfe 1992) Because of the distinct properties, the use of sweet-potato flour in the preparation of bread is restricted

^{1, 3, 4} Research Scholar, SHUATS

² Professor, SHUATS

Biscuits are baked dry products, usually with a golden brown crust and crispy texture (Fellows,1997).Whey was previously considered as waste because of its potential for spoilage. Now days however it is no longer considered as a waste product but treasure of nutritionally rich whey proteins (Annon, 1998). WPC has many health benefits and clinical importance. WPC is useful in the treatment of various diseases and health problems such as cancer and high cholesterol (Bounous et al., 1991; Smiters & McIntosh, 1998; St-Onge &Farnworth, 2000). It is effective in trauma, burn and renal failure (Peng et al., 2005; Miladinov et al., 2006). It has the ability to act as antibacterial and antiviral agent (Tanaka et al., 1999). Whey proteins are easily and readily digested and therefore useful in post operative care of patients. Its use is beneficial in diabetes, cardiac aliment, liver problem, arthritis, gout and antihypertensive. It is antitumour agent and giving antioxidant effect (Eric et al., 2003; Keri, 2004). WPC has immune-enhancing property due to which it can be used in treating HIV patients. Whey protein also acts as a sport food as whey proteins helps in speedy repairing of injured and torn muscle during practice and performance (Agin et al., 2001; Hoffman & Falvo, 2004). Whey proteins provide excellent nutritional values in nutrition foods formulated for infant, kids, adults and old aged people as growth tonic for body health maintenance.

Bakery industry in India is considered as one of the major food processing industry with an annual demand of over 2758 MT (Ministry of Food Processing Industries, 2013). India is known to be the second largest manufacturer of biscuits, first being USA. Bakery products are the most popular food consumed by all age groups and are gaining popularity as processed foods because of their availability, ready to eat convenience, and comparatively good shelf life.

As discussed above it is clear that sweet potato flour is rich in dietary fiber, functional fiber. Whey protein concentrate is rich in available protein content, high calcium and minerals, it can be considered as fortification for plain cookies.

Material and methods:

Sweet potatoes were procured locally from the field after harvesting. Roots were washed, trimmed and cured to make them free from soil and other foreign materials, rotting, insect damage and washed with common salt and made into slices, dried by using tray drier at 60°C for 6h and then Grinding, Sieving on 70 mesh. The prepared Sweet potato flour Packed in HDPE and stored for 6 months or more in sealed containers.

WPC were procured from Mahan proteins ltd., Delhi, India. Refined wheat flour, sugar, shortening (Amul Butter) were procured from local market of Allahabad (India) and kept at room temperature for further use. All chemicals used were of analytical grade.

Preparation dough for cookies

Dough was made in a laboratory mixer. Fat and sugar was creamed in a mixer with a flat beater for 2 min at slow speed. Sodium chloride was added to the resulting cream, and mixed for 5 min at high speed to obtain a homogeneous mixture. Finally, flour containing various proportions of sweet potato flour, and whey protein concentrate (80%) which had been sieved twice with baking powder was added, and mixed for 3 min at medium speed. The dough preparation, sheeting and moulding followed by different heat treatments like baking at 180⁰c for 15 mins, microwave heating at 180⁰c for 10 mins and frying at 180⁰c 8 mins.

Treatment combination with different heat treatments is given in the following Table 1.

HEAT TREATMENTS	TREATMENT COMBINATIONS	WHEAT FLOUR	SWEET POTATO FLOUR	WHEY PROTEIN CONCENTRATE WPC (80%)
Baking at 180 ⁰ c for 15 mins	T₀ HT₁	100	-	-
	T₁ HT₁	60	40	-
	T₂ HT₁	60	30	10
	T₃ HT₁	60	20	20
	T₄ HT₁	60	10	30
	T₅ HT₁	60	-	40
Microwave heating at 180 ⁰ c for 10 mins	T₀ HT₂	100	-	-
	T₁ HT₂	60	40	-
	T₂ HT₂	60	30	10
	T₃ HT₂	60	20	20
	T₄ HT₂	60	10	30
	T₅ HT₂	60	-	40
Frying at 180 ⁰ c 8 mins.	T₀ HT₃	100	-	-
	T₁ HT₃	60	40	-
	T₂ HT₃	60	30	10
	T₃ HT₃	60	20	20
	T₄ HT₃	60	10	30
	T₅ HT₃	60	-	40

TABLE :1 Treatment Combination Of Different Cookies

Sensory evaluation

The evaluation was done by 5 trained and semi trained panelists at Warner College of Dairy Technology, SHUATS. Judgments for developed cookies were made through rating products on a 5 point Hedonic scale (Ranganna, 1986) with corresponding descriptive terms ranging from 5 'like extremely' to 1 'dislike extremely' having different quality attributes

such as colour and appearance , body and texture ,flavor and taste, mouth feel and over all acceptability.

Microbial Analaysis

Standard plate count, Yeast and mould and Coli form was determined by using serial dilution pour plate method. The number of colonies appeared on dilution plates were counted, averaged and reported as cells per gram (cfu/gm) of the sample.

Statistical analysis

To determine the statistical significance of sensory and microbial evaluation of cookies, two way Analysis of Variance (ANOVA) technique followed by f-test was used. Means & SD's were calculated for results of all values are expressed as mean and standard deviation of five parallel measurements.

Results and discussion:

Organoleptic evaluation offers the opportunity to obtain complete analysis of various properties of food as perceived by human senses. Sensory evaluation is an important and best method for evaluating organoleptic properties of various products which provide quality measure and production control. To select the sensory attractive cookies prepared by different combinations of sweet potato and whey protein concentrate (80%) were subjected to sensory evaluation using 5 point hedonic scale. Colour and appearance , body and texture ,flavor and taste, mouth feel and over all acceptability were the parameters studied for selecting the better product among the different treatment combinations. Oraganoleptic evaluation of developed cookies was carried out by a panel of 5 semi trained panel members and best product was selected based on the results from the score card. The results of various quality attributes are present in the **Table 2** and **Fig 1**.

The results of sensory evaluation of cookies indicated that among the different treatment combinations, T₁HT₃ (4.90± 0.224) was better acceptable in terms of colour and appearance. T₀ HT₃ (4.60±0.548) for flavour & taste and T₃ HT₁ (4.70±0.27) for body and texture, T₃ HT₁ (4.50±0.500) for mouth feel, T₃ HT₁ (4.80±0.274) for over all acceptability in

The sensory evaluations for three heat treatments were good in taste. The body and texture consistency of fried cookies were reported to be too soft. As the sweet potato flour concentration increased, the softness is decreased. It was reported in baking and microwave

114 heat treatments where as in fried cookies the crispness is more in 40% sweet potato flour
 115 incorporated cookies (T_3 HT₁, T_3 HT₂) as per the sensory evaluation. The overall acceptability
 116 of the cookies was almost similar in baking and microwave heat treatments.

117

118 **TABLE: 2 Treatment Combinations of Different Cookies**

Heat Treatments	Treatment Combinations	Colour And Appearance	Flavour & Taste	Body And Texture	Mouth Feel	Over All Acceptability
Baking at 180 ⁰ c for 15 mins	T ₀ HT ₁	3.60±0.894	3.40±0.548	3.00±0.00	3.60±0.548	3.20±0.447
	T ₁ HT ₁	4.60±0.548	4.20±0.447	4.40±0.55	4.40±0.548	4.60±0.548
	T ₂ HT ₁	3.40±0.548	3.60±0.548	3.40±0.55	3.40±0.548	3.60±0.548
	T ₃ HT ₁	4.60±0.224	4.20±0.447	4.70±0.27	4.50±0.500	4.80±0.274
	T ₄ HT ₁	3.20±0.447	2.70±0.447	2.90±0.74	3.40±0.548	3.30±0.671
	T ₅ HT ₁	4.20±0.274	4.10±0.742	4.10±0.55	4.10±0.548	4.10±0.548
Microwave heating at 180 ⁰ c for 10 mins	T ₀ HT ₂	3.60±0.548	3.20±0.447	3.60±0.55	4.00±0.000	4.00±0.000
	T ₁ HT ₂	4.50±0.354	3.30±0.274	4.00±0.61	4.00±0.612	4.40±0.224
	T ₂ HT ₂	4.20±0.274	3.60±0.548	3.90±0.22	4.10±0.224	4.20±0.274
	T ₃ HT ₂	4.40±0.548	4.40±0.548	4.10±0.55	4.40±0.548	4.30±0.447
	T ₄ HT ₂	3.70±0.274	3.70±0.447	3.50±0.50	3.60±0.418	3.70±0.274
	T ₅ HT ₂	3.00±0.000	3.10±0.224	2.40±0.42	3.40±0.418	2.70±0.274
Frying at 180 ⁰ c 8 mins.	T ₀ HT ₃	4.40±0.548	4.60±0.548	4.20±0.84	4.40±0.548	4.60±0.548
	T ₁ HT ₃	4.90± 0.224	3.20±0.274	4.40±0.42	3.60±0.418	4.40±0.418
	T ₂ HT ₃	3.90±0.742	3.90±0.742	4.60±0.55	4.20±0.447	4.20±0.837
	T ₃ HT ₃	3.30±0.274	3.70±0.447	4.00±0.00	3.60±0.418	3.70±0.274
	T ₄ HT ₃	3.80±0.837	3.60±0.894	3.30±0.97	3.60±0.894	3.70±0.837
	T ₅ HT ₃	2.80±0.274	2.80±0.447	2.40±0.42	3.00±0.000	2.90±0.224
F- test		S	S	S	S	S
S. Ed. (±)		0.307	0.314	0.325	0.300	0.292
C. D. (P = 0.05)		0.618	0.632	0.654	0.604	0.588

119 All values are represented in MEAN ± S.ED

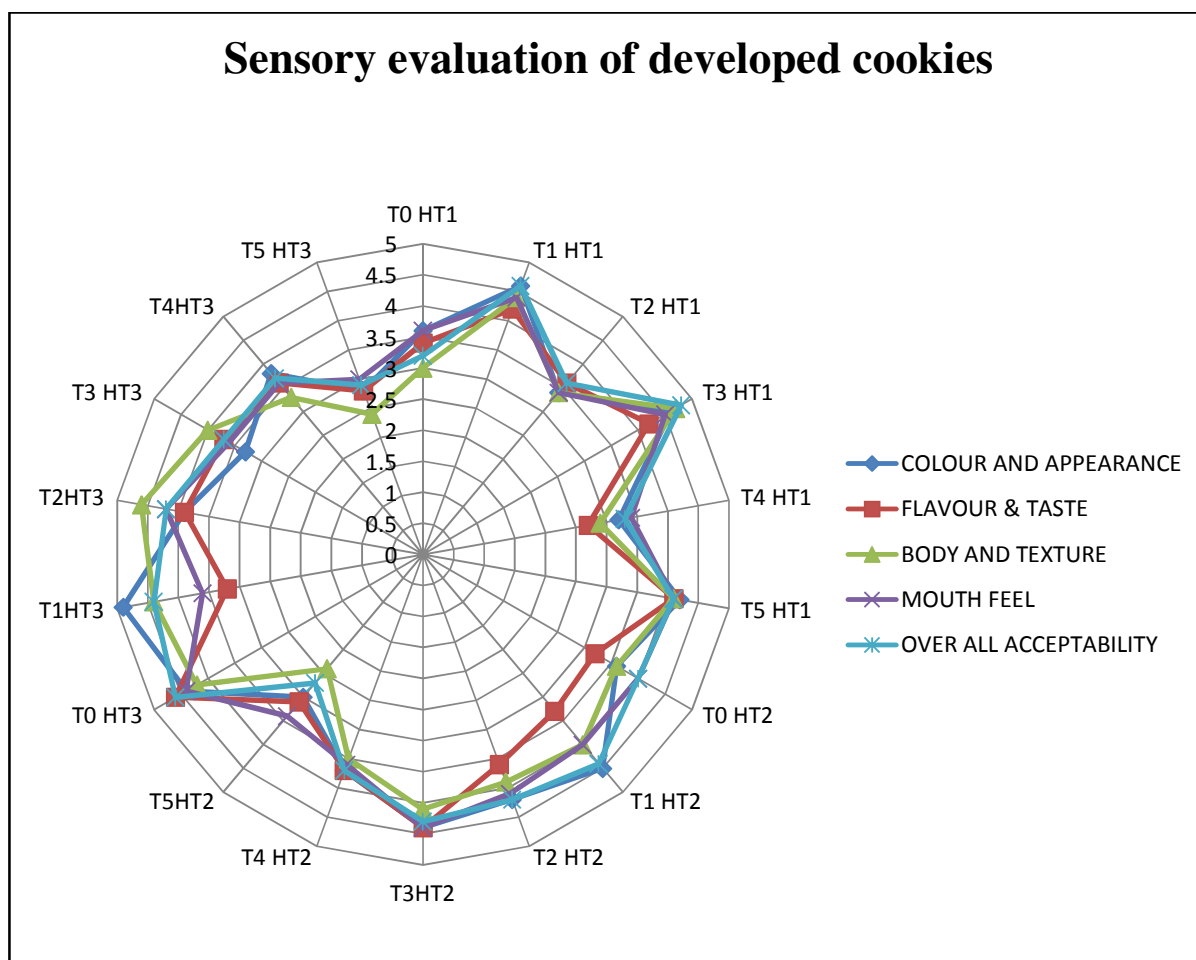


FIG: 1 Sensory evaluation of developed cookies

Microbiological assay

The results obtained for standard plate count (SPC) in developed cookies are presented in **TABLE 3**.

On 0th day the SPC for baked cookies was more in T₅ HT₁ (3.6 ± 1.4203) which was recorded in 40% whey protein concentrate (80%) incorporated cookies and least in T₂ HT₁ and T₂ HT₂ as the days increased standard plate count (SPC) gradually increased. Yeast and mould count was recorded nil in 0th and 15th where as on 30th T₅ HT₁, T₅ HT₂ and T₅ HT₃ was recorded as 0.20 ± 0.00 , 0.25 ± 0.434 and 0.12 ± 0.548 respectively.

Coli forms was highest on 30th day in T₁ HT₁ (2.80 ± 0.447) and least was recorded on 0th day (Nil) for all treatment. It was observed that the all the treatment combinations values are still within acceptable limit.

137

Table 3 Microbiological assays of formulated cookies

Heat Treatments	Treatment combinations	SPC(10^3) cfu/gm			Yeast and mould (10^3) cfu/gm			Coli forms(10^3) cfu/gm		
		0 th day	15 th day	30 th day	0 th day	15 th day	30 th day	0 th day	15 th day	30 th day
Baking at 180 ^o c for 15 mins										
	T ₀ HT ₁	1.8±0.844	2.6±0.894	3.2±0.8367	Nil	Nil	Nil	Nil	Nil	1.40±0.548
	T ₁ HT ₁	2.4±0.974	3.2±0.447	4.6±0.5477	Nil	Nil	Nil	Nil	Nil	2.80±0.447
	T ₂ HT ₁	1.4±0.729	1.8±0.447	2.2±0.8367	Nil	Nil	Nil	Nil	Nil	1.80±0.837
	T ₃ HT ₁	1.8±0.515	2.6±0.547	2.8±0.4472	Nil	Nil	Nil	Nil	Nil	1.32±0.460
	T ₄ HT ₁	2.2±1.305	2.6±0.547	3.2±0.4472	Nil	Nil	Nil	Nil	Nil	1.80±0.447
Microwave heating at 180 ^o c for 10 mins	T ₅ HT ₁	3.6±1.420	4.2±0.447	4.6±0.5477	Nil	Nil	0.20±0.00	Nil	1.48±0.449	1.92±0.179
	T ₀ HT ₂	2±0.746	3±0.707	4±0.7071	Nil	Nil	Nil	Nil	Nil	1.48±0.502
	T ₁ HT ₂	2.2±1.093	2.8±0.447	3.8±0.8367	Nil	Nil	Nil	Nil	Nil	1.88±0.522
	T ₂ HT ₂	1.4±0.426	1.8±0.447	2.2±0.4472	Nil	Nil	Nil	Nil	Nil	1.76±0.434
	T ₃ HT ₂	2.2±0.736	3.2±0.447	3.4±0.5477	Nil	Nil	Nil	Nil	Nil	2.36±0.590
	T ₄ HT ₂	2.8±1.419	3±0.0000	3.8±1.0954	Nil	Nil	Nil	Nil	Nil	1.36±0.498
Frying at 180 ^o c 8 mins.	T ₅ HT ₂	4.2±2.209	4.6±0.547	5.2±0.4472	Nil	Nil	0.25±0.434	Nil	1.52±0.449	1.56±0.518
	T ₀ HT ₃	2.2±0.736	3.2±0.447	4.6±0.5477	Nil	Nil	Nil	Nil	Nil	1.52±0.502
	T ₁ HT ₃	2±1.149	2.6±0.547	3.4±0.5477	Nil	Nil	Nil	Nil	Nil	2.20±0.447
	T ₂ HT ₃	1.6±0.527	2.2±0.447	2.6±0.5477	Nil	Nil	Nil	Nil	Nil	1.52±0.502
	T ₃ HT ₃	2.4±0.974	3.8±0.447	4.2±0.4472	Nil	Nil	Nil	Nil	Nil	2.04±0.089
	T ₄ HT ₃	3.2±1.055	3.6±0.547	4.2±0.8367	Nil	Nil	Nil	Nil	0.80±0.748	1.72±0.832
	T ₅ HT ₃	4.4±2.118	4.8±0.447	5.4±0.8944	Nil	Nil	0.12±0.548	Nil	1.96±0.080	2.68±0.460
F- test		S	S	S	-	-	S	-	S	S
S. Ed. (±)		0.430	0.321	0.414	-	-	0.304	-	0.167	0.334
C. D. (P = 0.05)		0.865	0.645	0.833	-	-	0.612	-	0.336	0.672

138

139 All values are represented in MEAN ± S.ED

140

141 Conclusion

142 From the present study, it can be concluded that the 20% SPF and 20% WPC (T₃ HT₁ and T₃
143 HT₂) supplemented cookie samples were nutritionally rich as well as more Sensory
144 acceptable product with regardless of both baking and microwave heat treatments. Evaluation
145 results revealed that 40% SPF (T₁ HT₃) are also good in taste. The standard plate Count, yeast
146 and mould count and coli forms of cookie samples were found within the acceptable limits.
147 Thus, the present our study concludes that the supplementation level of 20% SPF and 20%
148 WPC (T₃ HT₁) results are acceptable in sensory, textural and nutritional characteristics.

149 **References**

- 150 Agin, D.; Gallgher, D. and Wang, J (2001). Effect of whey protein and resistance exercise on body
151 cell mass, muscle strength & quality life in women with HIV AIDS. Vol. 15: 2431-2440.
152
- 153 Annon (1998). Whey Update. Dairy Industries International. Vol. 63(8): 18- 19.
154
- 155 Bounous, G.; Batist, G. and Gold, P (1991). Whey proteins in cancer prevention. Cancer Letter. Vol.
156 57: 91-94.
157
- 158 Eric, D.; Bastian, W. and James, H (2003). Emerging health benefits of whey. Dairy Council
159 Digests. Vol. 74: 31-36.
160
- 161 Fellows, P. 1997. Traditional foods processing for profit. Intermediate Technology Publications Ltd,
162 103-105 Southampton Row, London WC 1B 4HH, UK Pp. 62-63.
163
- 164 Hoffman, J.R. and Falvo, M.J (2004). Protein- Which is best Journal of Sport Science and
165 Medicine. Vol. 3: 118-130.
- 166 Horton, D. and Fano, H (1985). Potato Atlas, International Potato Center (CIP), Lima, Peru. pp.136.
167
- 168 Jones (1965) Genetic variation in color of sweet potato flour related to its use in wheat-based
169 composite flour products. Cereal Chemistry 74: 681-686.
170
- 171 Keri, M. (2004). Therapeutic applications of whey protein. Alternative Medical Review. Vol. 9:
172 136-156
- 173 Miladinov; Vesselin, D.; Roscetti; Riccardo, D (2006). Dietary supplement for renal dialysis
174 patients. US Patent 7 067 156.
175
- 176 Peng, X.; Yan, H.; You, Z.; Wang, P. and Wang, S (2005). Clinical and protein metabolic efficacy
177 of glutamine granules-supplemented enteral nutrition in severely burned patient. Burn. Vol.
178 31(3): 342-346.
179
- 180 Ranganna S (1986). Handbook of analysis of and quality control of fruit and vegetable products. 2
181 nd edition Tata Mc Graw hil Publishing Company Ltd, New Delhi.
182
- 183 Smiters, G.W. and McIntosh, G.H (1998). Anti cancer effects of whey proteins. Proceedings of the
184 Second International Whey Conference. p 306 –309.
185
- 186 St-Onge, M.P. and Farnworth, E.R (2000). Consumption of fermented and non-fermented dairy
187 products: Effect on cholesterol concentrations and metabolism. American Journal of Clinical
188 Nutrition. Vol. 71: 674-681.
189
- 190 Tanaka, K.; Ikeda, M. and Nozaki (1999). Lactoferrin inhibits hepatitis C virus viremia in patients
191 with chronic hepatitis C: a pilot study. Japanese Journal of Cancer Research. Vol. 90: 367-
192 371.
- 193 Woolfe, J.A (1992). Post- harvest procedure: II Processing, In Sweet potato: an untapped food
194 resource, Cambridge Univ. Press. 294-355.
195