Original Research Article

Physical and sensory attributes of dhokla made with sweet potato and flaxseed flours

ABSTRACT

Sweet potatoes are quite nutritious. It provides more than 90% of the nutrients per calorie that the majority of individuals require. It is a source of carbohydrates, as well as vitamins C, E, B1, B2, niacin, B5, folic acid, minerals like potassium, calcium, zinc, and magnesium, dietary fiber, and significant amounts of iron. Flaxseed is also one of those nutrient-rich ingredients that is easily incorporated. It is rich in essential omega-3 fatty acid, alpha linolenic acid, protein and dietary fiber. The combination of flaxseed proteins with mucilage, a byproduct of flaxseed, may enhance their abilities in food formulation. An experiment was carried out to evaluate theeffect of different composition ratio of semolina, sweet potato and flaxseed flours on physical and sensory attributes of dhokla.The porosity and cooking time of dhokla were found to be maximum whereas weight had no effect and height was minimum by substituting semolina with sweet potato and flaxseed flour.On the basis of sensory evaluation, all dhokla samples were acceptable for consumption and T_1 sample of dhokla had highest score at both composition ratio and storage period according to the panelist. The highest overall acceptability score was found for T_1 sample of dhokla.

Keywords: flaxseed; dietary fiber;niacin;omega-3 fatty acid; alpha linolenic acid.

1. INTRODUCTION

The concept of optimal nutrition, which addresses the need to fully satisfy the body's requirements, is the base for modern ideas of healthy eating. A balanced diet must include cereals, legumes, vegetables, fruits, and oilseeds because they are the main sources of vitamins and dietary fiber**[1-3]**.
I. batatas has been utilized extensively as a source of energy and phytochemicals for both human and animal nutrition. It is cultivated throughout many tropical and subtropical areas. As well as being a staple food, sweet potatoes are also utilized as a root vegetable (including its fleshy roots, delicate leaves, and petioles), a snack food, animal feed, a source for industrial starch extraction and fermentation, and for a variety of processed goods **[4-7].**The flesh of a sweet potato might be creamy, creamy white, yellow, orange, or purple. The most often cultivated and consumed colors are orange, white, and creamy **[8-9].** It is most frequently used as a snack food, many other countries utilize it as a staple diet or as a substitute for rice.

Flaxseeds can be added to cereals in the form of nuggetsto create a crunchy feel as well as in the form of flour to boost the nutritional value in the products. Omega-3 and Omega-6 fatty acids found in abundance in flaxseed are helpful in lowering triglycerides and cholesterol levels in the blood. In addition to being rich in minerals and omega-3 fatty acids, flaxseeds contain significant amounts of dietary fiber, including lignans. Soluble fiber and other components of the flaxseed fraction may affect insulin secretion and the capacity of this substance to keep plasma glucose levels in a healthy range. Flaxseed has anticancer effects, and lignans may enhance those qualities **[10].**

Indigenous fermented foods, which are deeply ingrained in our tradition and culture and have been prepared and consumed since the dawn of time, have a high nutritional value, good nutrient bioavailability, good digestibility, and a variety of flavors, aromas, and textures in their food substrates. Numerous fermented rice-based dishes, including idli, dosa, and dhokla **[11]** are already well-liked. Dhokla is an Indian cake made from lactic acid fermentation that is typically eaten for breakfast or as a snack. It has a spicy, almost sweet flavor **[12-14].** However, because it is made with a batter that contains only bengal gram dhal, rice, or semolina, and is then fermented, steamed in a pie dish, cut, and seasoned **[11,15].** The traditional dhokla must be transformed into a nutritious version with increased nutrient content through value addition in order to be used as a functional food in addition to

the daily diet **[14].**In this study, a recipe for dhokla that uses several combinations of semolina, sweet potato, and flaxseed flour is presented along with an investigation of the physical and sensory qualities that make dhokla popular.

2. MATERIALS AND METHODS

2.1. Preparation of Semolina, Sweet Potato and Flaxseed Flours Incorporated Dhokla

Different ratios of semolina, sweet potato and flaxseed flours were weighed. The flours were combined with curd and water to make a thick batter that was then allowed to rest for 30 minutes before being used in the preparation of Sweet Potato flour integrated dhokla batters. Then, to make dhokla, add a leavening agent (ENO-fruit salt regular) to the batter and place it into a greased flat tray for steaming. Dhokla were cooled at room temperature and placed in PET jars. The following four different composition of flours blends, including the control were prepared.
T0 = Semolina (95%), Flaxseed Flour (5%)
T1= Semolina (75%), Sweet Potato Flour (20%), Flaxseed Flour (5%)
T2 = Semolina (55%), Sweet Potato Flour (40%), Flaxseed Flour (5%)
T3 = Semolina (35%), Sweet Potato Flour (60%), Flaxseed Flour (5%)

2.2. Physical and Sensory Analysis of Semolina, Sweet Potato and Flaxseed Flours Blended Dhokla

The freshly prepared dhokla from semolina, sweet potato and flaxseed flour blends were analyzed for physical properties (weight, height, porosity and cooking time) using standard methods.Weight of dhokla batterwas determined by a digital pan balance in avessel, in which batter was to be prepared. Then vessel was weighed with batter before addition of leavening agent and recorded as weight before cooking. After steaming, vessel with product was placed directly on weighing balance and value was recorded as weight of product after cooking. The height of the dhokla wasmeasured by using a clean transparent ruler (15 cm). Batter was prepared in a flat bottomed vessel. Ruler was placed vertically into centre and four corners of batter until it touched bottom of vessel and then removed. This was done before addition of leavening agent. This value was recorded as height before cooking. Similarly, after cooking, ruler was inserted vertically into centre of product and recorded as height after cooking. To analyze porosity, dhoklawas cut into four equal parts and length and breadth of each part was noted. Then number of pores on both sides of four parts were recorded and added. Average number of pores per cm^2 was calculated by dividing total number of pores by number of sides. This value was then divided by length × breath to obtain final porosity/ cm^2 value of dhokla.And the cooking time evaluation the amount of time required for cooking was calculated as the interval between when the cooker was turned on for steaming and when it was turned off.Sensory evaluation for the dhokla developed was done using the 9-point hedonic scale upto storage interval of 30 days till 90 days. The 9- point hedonic scale is also called as the degree of liking scale and is commonly utilized to check the acceptability of the products amongst the consumers. Acceptability of samples was judged by 20 semi-trained panelists and the samples were subjected to a nine-point hedonic test to determine the consumers' degree of liking. The sensory characters such as, color, mouth feel, taste and overall acceptability of the semolina, sweet potato and flaxseed flour blended dhokla was judged by this method.

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2.3. Statistical Analysis

To test the significance of the effect of treatment and storage period on quality parameters, analysis of variance (ANOVA) of the collected data for different properties was carried out as applicable to experiments of randomized design of the data record. Data was analyzed with the help of MS Excel Spreadsheet and SPSS software. The analysis of samples was carried out at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Physical Properties of Dhokla

The result of physical properties (weight, height, porosity and cooking time) of sweet potato dhokla were presented in **Table 1**.The weight of batter after rehydration was the same for all samples but rose by 20 g when it was steamed **(Table 1)**, showing that the incorporation of sweet potato flour (%) had no effect on the weight of the finished product at any stage of the formulation or preparation process. **[11]Ravi *et al.,* 2010** also reported similar observations.The batter's height was the same for all samples, and after being steamed, it gradually decreased in height. T_0 or control dhokla had the maximum height (2.7 cm), whereas the T_3 dhokla, which contained semolina 35%, 60% sweet potato flour and 5% flaxseed flour, had the lowest height (2.1 cm). Similar decreasing trend were also showed by **[11]Ravi *et al.,* 2010.** The difference in height between the variations (0.1 cm) and the control (0.6 cm) was not as high demonstrating that the amount of sweet potato flour present had an adverse effect on the dhokla's ability to rise. This could be because sweet potato flour incorporation results in a compact product causing a decrease in height of final product**[16].**Dhokla's porosity reduced as sweet potato flour incorporation increased **(Table 1)**.The porosity was found to be highest in dhokla T_3 (0.53%), which contained semolina 35%, 60% sweet potato flour and 5% flaxseed flour, and lowest in (T_0) or control dhokla (2.96%), which contained 95% semolina and 5% flaxseed flour. Dhokla with T_3 was more compact than control dhokla in the sample with semolina 35%, 60% sweet potato flour and 5% flaxseed flour inclusion. Between T_2 (0.91) and T_3 (0.53) sweet potato flour incorporation, there was barely any difference in porosity. The porosity of the product reduced with an increase of sweet potato flour because sweet potato inclusion produces a compact product, which causes a decrease in porosity. Similar observations were also reported by**[11]Ravi *et al.,* 2010.** A more significant difference was observed between the control and variants. Emulsifier blend additions, which increase specific volume and porosity of rice cakes and result in softer products **[17],** may help increase porosity of sweet potato flour incorporated dhokla.

Table 1: Physical properties of Dhokla

Sample	Weight (gm)		Height (cm)		Porosity (%)	Cooking time (min)
	Before cooking	After cooking	Before cooking	After cooking		
T_0	122	142	1.5	2.7	2.96	18
T_1	122	142	1.5	2.5	1.60	20
T_2	122	142	1.5	2.4	0.91	22
T_3	122	142	1.5	2.1	0.53	24

Description

T_0 = Semolina (95%), Flaxseed Flour (5%)
T_1= Semolina (75%), Sweet Potato Flour (20%), Flaxseed Flour (5%)
T_2 = Semolina (55%), Sweet Potato Flour (40%), Flaxseed Flour (5%)
T_3 = Semolina (35%), Sweet Potato Flour (60%), Flaxseed Flour (5%)

All samples showed a constant rise in the amount of time needed to cook food **(Table 1)**.T_0or control dhokla in which sample having semolina 95% and flaxseed flour 5% took minimal time (18 min), while T_3 dhokla, which included semolina 35%, sweet potato flour (60%), flaxseed flour (5%) incorporated dhokla took the maximum time (24 min). The difference in cooking time increased by 2 minutes with increement in sweet potato flour incorporation, showing that sweet potato flour incorporation and the duration of cooking are directly proportional. It has been noted that adding sweet potato flour produces a compact product, which suggests that the steaming process is delayed since cooking takes longer as sweet potato flour concentration increases. Strong correlations between cooking time and sweet potato flour concentration were discovered, showing that as sweet potato flour concentration increased, the time required to cook the product also increased. Similar observations were also observed by**[11]Ravi *et al.,* 2010.**

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3.2. Sensory Analysis of Dhokla

The sensory analysis of dhokla supplemented with sweet potato flour was determined at the time of 0 day and during storage of 4 and 6 days was shown in **Table 2.**The quality of food, aside from microbial

aspects, is generally based on color, mouth feel, taste and overall acceptability. The color for fresh sample was highest for (T_0) or control dhokla (7.91) and lowest value (7.36) was observed for dhokla (T_3). The study revealed that color of dhokla gradually decreased during storage period of 6 days. Highest color was found in T_0 or control dhokla and lowest in T_3 dhokla just after preparation and also similar after 6 days of storage. The mouth feel for fresh sample was highest for (T_1) dhokla (8.31) and lowest value (7.72) was observed for dhokla (T_3). The study revealed that mouth feel of dhokla gradually decreased during storage period of 6 days. Highest mouth feel was found in T_1 dhokla and lowest in T_3 dhokla just after preparation and also similar after 6 days of storage. The taste for fresh sample was highest for (T_1) dhokla (8.50) and lowest value (7.85) was observed for dhokla (T_3). The study revealed that taste of dhokla gradually decreased during storage period of 6 days. Highest taste was found in T_1 dhokla and lowest in T_3 dhokla just after preparation and also similar after 6 days of storage. The overall acceptability for fresh sample was highest for (T_1) dhokla (8.18) and lowest value (7.64) was observed for dhokla (T_3). The study revealed that overall acceptability of dhokla gradually decreased during storage period of 6 days. Highest overall acceptability was found in T_1 dhokla and lowest in T_3 dhokla just after preparation and also similar after 6 days of storage.

Table 2: Effect on storage of sensory attributes on different composition of dhokla

Sample	Color			Mouth feel			Taste			Overall Acceptability		
	0 day	4 days	6 days	0 day	4 days	6 days	0 day	4 days	6 days	0 day	4 days	6 days
T_0	7.91 ± 0.38	7.89 ± 0.65	7.85 ± 0.41	8.09 ± 0.53	7.98 ± 0.69	7.76 ± 0.61	8.32 ± 0.53	8.24 ± 0.41	8.11 ± 0.45	8.10 ± 0.67	8.03 ± 0.41	7.90 ± 0.35
T_1	7.75 ± 0.80	7.74 ± 0.71	7.72 ± 0.75	8.31 ± 0.64	8.10 ± 0.67	7.89 ± 0.49	8.50 ± 0.58	8.31 ± 0.41	8.26 ± 0.38	8.18 ± 0.51	8.05 ± 0.53	7.95 ± 0.48
T_2	7.62 ± 0.26	7.63 ± 0.31	7.63 ± 0.67	7.96 ± 0.74	7.84 ± 0.78	7.62 ± 0.72	8.09 ± 0.61	7.87 ± 0.58	7.57 ± 0.63	7.89 ± 0.71	7.78 ± 0.74	7.60 ± 0.38
T_3	7.36 ± 0.49	7.35 ± 0.68	7.32 ± 0.71	7.72 ± 0.64	7.60 ± 0.74	7.36 ± 0.67	7.85 ± 0.58	7.71 ± 0.47	7.45 ± 0.53	7.64 ± 0.49	7.55 ± 0.72	7.37 ± 0.76

Description

T_0 = Semolina (95%), Flaxseed Flour (5%)
T_1= Semolina (75%), Sweet Potato Flour (20%), Flaxseed Flour (5%)
T_2 = Semolina (55%), Sweet Potato Flour (40%), Flaxseed Flour (5%)
T_3 = Semolina (35%), Sweet Potato Flour (60%), Flaxseed Flour (5%)

4. CONCLUSION

This study was carried out to evaluate the effect of the replacement of semolina with sweet potato flour and flaxseed flour on the physical and sensory characteristics of dhokla. The porosity and cooking time of dhokla were found to be maximum whereas weight had no effect and height was minimum by substituting semolina with sweet potato and flaxseed flour. The mixture of semolina with sweet potato flour and flaxseed flour could make a good baking product, which should increase its economic value. This decreases the import of semolina, reduce the use of sugar, and increase the value of sweet potato. However, dhokla made using 20% sweet potato flour and 5% flaxseed flour substitution (T_1) was acceptable to consumers. This leads to the conclusion that improved consumer-acceptable dhokla can be prepared by substituting up to 20% sweet potato flour and 5% flaxseed flour in semolina.

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