# Value addition of dhokla for diabetics with oats and jowar flour

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Abstract: Value addition of oats and jowar flour was done to develop dhokla as a snack for diabetics. After standardizing the basic recipe, three variations were developed by addition of oats and jowar flour and were named swast dhokla-1 (SD-1), swast dhokla-2 (SD-2) and swast dhokla-3 (SD-3) respectively. To the basic dhokla, addition of oats and jowar flour was done to replace the rice from the recipe at 33%, 66% and 100%. Nutrient value calculation of Energy, protein, and fat followed by calcium and magnesium was done to scrutinize the effect of substitution of rice with oats and jowar flour on the nutrient content. Cost analysis was done to draw an analogy between the basic and the variations. Sensory evaluation was conducted with 12 panelists from the department of food and nutrition at the University College for women, koti in order to distinguish the most accepted variation. Statistical analysis using paired t-test was done on the mean scores. Next the basic and the most accepted variations were then subjected to nutrient analysis so as to compare their dietary fibre and carbohydrate content. The results of nutrient value calculation showed that SD-3 was superior among all in terms of its nutrient content with Energy- 173 Kcal, Protein 12.6g, Fat 9.4g, Calcium 52.3 mg and Magnesium 87 mg. Cost of ingredients used for development of the basic, SD-1, SD-2 and SD-3 was Rs 6.5, Rs 6.9 Rs 7.3 and Rs 7.7 respectively. The data from sensory analysis revealed that SD-1 was most accepted variation with average mean score for taste 3.6, texture 3.9, color 3.4, appearance 3.4, and overall acceptability 3.58. The nutrient analysis comparison of the basic and the most accepted variation that is SD-1 indicated that the dietary fibre and carbohydrate content of the basic was 8.0g and 33.2 g respectively, and that of SD-1 was 11.2g and 38.6 g respectively. It was thus concluded that although SD-3 with 100% substitution was found to be superior in its nutrient content, SD-1 with 33% substitution was the most accepted in terms of its sensory qualities. And this newly developed SD-1 had 3.2g more fibre, and required almost (+Rs0.4) the same cost for its production when compared the basic. The SD-1 and basic had little difference in terms other nutrients. Therefore for a similar price healthy variation of dhokla with better fibre, and nutrient content having oats and jowar flour as functional ingredients can be made for diabetics.

## Keywords: Dhokla, value addition, oats, jowar, fibre, diabetics.

## I. INTRODUCTION (HEADING 1)

The oat (*Avena sativa*), often called the common oat, is a species of grain grown for its seed Oats is rich in beneficial starch fractions. Almost 60% of its grain consists is of starch[1]. This includes Resistant starch and slowly digestible starch. Studies illustrated that a single-oatmeal can significantly reduce the acute postprandial glucose or insulin responses when compared with the control meal. Whole oats contain significant amount of dietary fibre, especially water soluble  $(1 \rightarrow 3)$   $(1 \rightarrow 4)$   $\beta$ -glucan [3]. The  $\beta$ -glucan content in oat ranges from 1.73 to 3.49 /100 g [6].

 $\beta$ -glucan is a soluble and fermentable fiber, which cannot be decomposed and absorbed in the small intestine but can be fermented in the colon. The  $\beta$ -glucan is reported to increase the viscosity of food bolus, delay gastric emptying and lengthen intestinal transit time, slow the absorption of nutrients especially the carbohydrates, and enhance the satiety [5]. It was also reported that  $\beta$ -glucan could slow the appearance of glucose in plasma, resulting in longer-lasting insulin secretion which exert a prolonged inhibition of endogenous glucose production and lipolysis. Thus proving beneficial for diabetics.

Apart from  $\beta$ -glucan, oats are also a rich source of magnesium, which is an important co-factor for many enzymes including enzymes involved in the metabolism of glucose and insulin. Additionally, an inverse association between magnesium in relation to type 2 diabetes was reported. This has been attributed to the fact that free Mg2+ is the primary regulator of glycolysis and the Krebs cycle, Mg2+ is the regulator par excellence of metabolism, largely through its role as a cofactor for all phosphoryl transfers in the cell.[4].

"Jowar"scientifically called Sorghum vulgare, also called great millet, is the cereal that thrives in semi arid regions and provides valuable human food in Nigeria, India and china [2]. Jowar is a millet that contains more protein, fire, minerals and vitamins, which are generally deficient in Indian diets that majorily cereal based. Jowar has eight times more fibre than rice. Though jowar is rich in carbohydrates (72%), it releases sugar very slowly in the body due to its dietary fibre content and therefore has low glycemic index. The tannin-rich bran of sorghum has enzymes that inhibit the absorption of starch, which can help to regulate insulin and glucose levels in the body. Thus, it helps to manage the rise in blood sugar levels after meals in diabetics.

Thus oats and jowar are proven and researched whole grains that have been shown to be effective in dietary management of diabetics due to their slow release of blood sugar. One of the primary reasons behind their ability in controlled glycemic response has been attributed to their dietary fibre content. Incorporating oats and jowar in everyday diet of diabetics could thus help in not only increasing the dietary fibre consumption per day but also increase other minerals like magnesium and calcium that have been speculated to play a role in regulating glucose metabolism.

With this view, in this study value addition of oats and jowar flour was done to dhokla in varying proportions to identify the level of acceptance and analyze whether the incorporation leads to increase in dietary fibre

# **II. MATERIALS AND METHOD**

# Aims and objectives:

- 1. Value addition using oats and jowar to develop swast dhokla variations.
- 2. To standardize the ingredients and method involved in the development of the products.
- 3. To estimate the nutrient composition of the product.
- 4. To conduct cost analysis
- 5. To conduct sensory evaluation of the products developed and find the most accepted product.

6. To conduct nutrient analysis so as to calculate and analyze the carbohydrate content and total dietary fibre of the basic and

# most accepted variation.

# Place of study

This study was carried out at the Department of Food and Nutrition, University College for Women, Koti.

# **Procurement of the sample**

Ingredients were brought from the local market, koti, hyderabad. These included oats and jowar flour along with other ingredients like split chickpeas (chana dal) blackgram (urad dal), oil and spices. Procured ingredients were then used for standardization of the basic recipe from which the products were formulated.

The cost of all the ingredients was noted for conducting cost analysis.

# Standardization

Standardization is a process where the recipe is tested and found consistently satisfactory in quality and yield. It is a gradual trial and error process. Use of standard recipe is a prime factor in developing good product. This includes standardizing the quantities of each ingredient, raw and cooked weights, preparation time.

Recipe standardization of the dhokla was done in a four trials. Initial trial were done with Bengal gram flour and the texture was found unsatisfactory.

Later consecutive 3 trials by fermenting dal and rice were done. And the recipe was finally standardized.

# Formulation of basic and swast dhokla (sd)

Dhokla is well known, as it is one of the popular and traditional gujrati recipe. The method of preparation is almost the same for basic and variations. The difference exists in the amount of rice substituted with oats and jowar flour. In the variations a combination of oats and jowar of 5g, 10g, and 15g was added. To basic dhokla addition of oats and jowar flour was done to replace the rice from the recipe at 33%, 66% and 100%

INGREDIENTS BASIC VARIATION 1 VARIATION 2 VARI					
INGREDIENTS	DASIC	SD-1	SD-2	SD-3	
Rice	15g	10g	5g	-	
Oats		2.5g	5g	7.5g	
Jowar flour	-	2.5g	5g	7.5g	
Urad dal	15g	15g	15g	15g	
Chana dal	30g	30g	30g	30g	
Curd	15g	15g	15g	15g	
Green chilly	1 whole (3 inch)	1 whole (3 inch)	1 whole (3 inch)	1 whole (3 inch)	
Ginger	1 inch	1 inch	1 inch	1 inch	
Salt	1/4 tsp	1/4 tsp	1/4 tsp	1/4 tsp	
Baking soda	1/4 tsp	1/4 tsp	1/4 tsp	1/4 tsp	
Hot Water	1 tbsp	1 tbsp	1 tbsp	1 tbsp	
Oil	5 ml	5 ml	5 ml	5 ml	
Mustard seeds	¼ tsp	¹⁄₄ tsp	1⁄4 tsp	1⁄4 tsp	

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## Method of preparation:



FIGURE 1 Steps in preparation of dhokla

## Basic recipe:

**Soaking**: Wash and soak the chana dal, urad dal and rice in water each separately for 6 hours. Next drain the water from the dals and rice. Exceeding the soaking time might lead to stickiness and off smell development.

**Batter preparation**: Grind the dals and rice together along with green chilly, ginger and curd into a paste like consistency. Depending on the type and quality of rice and dal the batter may be coarse and require a teaspoon of water to arrive at paste consistency.

**Fermentation:** The batter is allowed to ferment overnight for 10-12 hours. The batter is expected to rise a little. Hence a deep dish is preferred for this step and the dish is closed with a lid.

**Steaming:** Prepare to steam, by boiling 2 glasses of water in a vessel with a sealed lid, to avoid loss of the steam. Grease the thali with 2.5 ml oil in which dhokla are to be steamed. Take the fermented batter and add salt, soda and 1 tbsp of hat water and stir gently, quickly add to the greased thali and put it in the steaming vessel and seal it. Allow to steam for 20 minutes. Once done check the doneness by poking a toothpick, it should come out clean. Remove from vessel when done.

**Dishing out and cutting:** The dhoklas are to be dished out of the thali by inverting it. Then, medium sized squares are cut out uniformly using a knife.

**Tempering:** Next tempering is prepared by heating 2.5 ml of oil and adding mustard seeds. Its removed from heat when the seeds start to splutter. The hot tempering is poured over the dhoklas. The dhoklas are served hot with chutney.

**Cooling and packing:** The cooling process can be done by letting it cool at room temperature. Packing is done after the resistant heat is lost and dhokla is sufficiently cooled in food grade plastic boxes

## Variations of recipe-"Swast dhokla":

**Soaking:** Wash and soak the chana dal, urad dal and rice in water each separately for 6 hours. Next drain the water from the dals and rice. Exceeding the soaking time might lead to stickiness and off smell development.

**Batter preparation:** Grind the dals and rice together along with green chilly, ginger and curd into a paste like consistency. To this mix for variations 1,2 and 3 add oats in 2.5g, 5g and 7.5 g along with jowar flour in 2.5g, 5g and 7.5g respectively. Therefore the variations 1,2 and 3 contained 5g, 10g, and 15g of oats and jowar flour combined. Depending on the type and quality of rice and dal the batter may be coarse and require a teaspoon of water to arrive at paste consistency.

**Fermentation:** The batter is allowed to ferment overnight for 10-12 hours. The batter is expected to rise a little. Hence a deep dish is preferred for this step and the dish is closed with a lid.

**Steaming:** Prepare to steam, by boiling 2 glasses of water in a vessel with a sealed lid, to avoid loss of the steam. Grease the thali before pouring the dhokla batter. Take the fermented batter and add salt, soda and 1 tbsp of hat water and stir gently, quickly add to the greased thali and put it in the steaming vessel and seal it. Allow to steam for 20 minutes. Once done check the doneness by poking a toothpick, it should come out clean. Remove from vessel when done.

**Dishing out and cutting:** The dhoklas are to be dished out of the thali by inverting it. Then, medium sized squares are cut out uniformly using a knife. The recipe yields 8-9 dhoklas and serves 2 people.

**Tempering:** Next tempering is prepared by heating oil and adding mustard seeds. Its removed from heat when the seeds start to splutter. The hot tempering is poured over the dhoklas. The dhoklas are served hot with chutney.

Cooling and packing: The cooling process can be done by letting it cool at room temperature. Packing is done after the resistant heat is lost and dhokla is sufficiently cooled in food grade plastic boxes.

# Nutritive value calculation:

The nutritive value of the basic and the variations was calculated. Energy, protein, fat, vitamin calcium and magnesium were detrmined. This was accomplished using Indian food composition tables [7] and USDA Branded Food Products Database of United States Department of Agriculture Agricultural Research Service[8]. The values so calculated were tabulated, which would enable to examine the change in nutrients that occurs upon addition of oats and jowar flour to the basic in varying proportions.

## Cost analysis:

Food cost of the basic and the variations for the developed products was estimated. The products that were procured from the local market were bought in bulk. The cost of ingredients used for development of each product (basic and variation) was done individually. The price of each of the ingredient was then calculated by cross multiplying it with the price of bulk ingredients, to obtain the total cost that took to develop the product as per the recipe .

#### Sensory evaluation:

Sensory evaluation is a combination of different senses of perception coming into play in choosing and eating a food product Appearance, flavor, and mouth feel decide the acceptance of food. The sensory evaluation was carried out in the Food and Nutrition department Koti. Sensory evaluation was done to evaluate the most accepted variation of dhokla

## Selection of panelists:

12 panelists were selected for the trials for evaluation of sensory attributes of prepared recipes. The panelists were selected students with prior knowledge and experience of sensory evaluation techniques. The panelists belonged to department of Food and Nutrition, University College for Women, Koti.

## Score card-5 point hedonic scale:

The selected judges were requested to evaluate the products for various sensory characters by ranking the reponses in five point hedonic scale as used in a similar study by [9].

The judges were requested to score the products for different sensory characteristics namely Taste, Texture, Colour, Appearance and Overall acceptability. To calculate the score of each product each descriptor was assigned a score value The range of score varied between 1 to 5 indicating, 5 as Excellent, 4 as Very good, 3 as Good, 2 as Fair and 1 as Poor. The judges were requested to evaluate the products with the help of the given score card.

# Nutrient analysis:

The nutrient analysis of Fibre along with carbohydrate which determine the glycemic response of the basic and the most accepted of the developed products were determined according to the standard analytical methods (AOAC).

## Total dietary fibre estimation:

Total dietary fibre is made up of complex an heterogenous polymeric materials such as soluble and insoluble polysaccharides and non digestible oligosaccharides as well as a range of hydrophobic compounds such as cuteins, suberins and lignins. Total dietary fiber was analyzed using enzymatic gravimetric method given by AOAC.

## **Total Carbohydrate estimation:**

Total available carbohydrate is the sum of total free sugars and total starch. Free sugars are individual monosaccharides (galactose, glucose and fructose) and disaccharides (sucrose, lactose and maltose). Determination of carbohydrate was done using method as per AOAC.

#### Statistical analysis of data:

The data collected from the sensory trials will be compiled and classified. Mean for the sensory attributes of basic and variations were found. Paired 't' test was applied to find out the significance of difference between mean scores of the sensory properties of the basic and the three variations.

## **III.** RESULTS AND DISCUSSION

#### Nutritive value calculation:

The Nutritive value of the basic dhokla and the variations, Swast dhokla-1, Swast dhokla-2 and Swast dhokla -3 are presented in table 4.1. The nutrients calculated using Indian food composition tables for the raw ingredients of the recipe were, energy, protein, fat, calcium and magnesium. Results of the nutrient calculation revealed that the energy for the basic and variation SD-1, SD-2, SD-3 was 274 Kcal, 273.9 Kcal, 273 Kcal and 273 Kcal , Protein was 12g,12.3g, 12,4g and 12.6g , Fat was 8.8g, 9.2g 9,2g, and 9.4g, calcium was 51g,51.4g, 52.3g and 52g, Magnesium was 72.5g, 77.4g, 82.3g and 87g respectively.

The scrutiny of the data revealed that there was a slight decrease in the calorific value of the SD-1, SD-2, and SD-3 when compared to that of the basic variety. It was observed that the addition of jowar and oats resulted in the increase in protein, fat, calcium, and magnesium content of the variations as compared to that of basic. It is seen that protein was highest in SD-2 and SD-3 (12.4g and 12.6g respectively) along with protein these two varieties also were superior in terms of their calcium and magnesium content (52mg, 82.3mg and 52.3mg, 87mg) respectively , these results are similar to the study conducted by Nutan 2015 wherein the Nutritional composition of blend flours showed that Type-III and Type-VI had significantly (P<0.05) higher content of protein (11.78 and

11.25%), were superior in terms of nutrient composition [10]. It is thus inferred that increase in the amount of oats and jowar flour results in increase in the protein, fat, calcium and magnesium content.

The increase in the fat content of the variations with respect to basic is attributed to the oats fatty acid content. This increase is alos noted in the study done by Rzedzeki et al., 2000 where the product containing oats had a nutrient value of 7.42 and the other corn variety had a fat content of 1.1 [11]. This increase in fat due to oats does not attribute a negative effect on Lipid profiles as proven by the clinical randomized controlled trial study done by Van horn 1986 wherein dietary fat composition remained similar among the three groups during weeks 7 to 12. At baseline, the group mean cholesterol level was 208.4 mg/dl. After 6 weeks of dietary fat intervention, the level was 197.6--a fall of 10.8 mg/dl (5.2%). At 12 weeks, the mean serum cholesterol level fell further, by 5.6, 6.5, and 1.2 mg/dl for groups 1, 2, and 3, respectively.. Pooled results indicated that the addition of oat products at a moderate and practical level enhanced serum lipid response (p less than .05) to a fat-modified eating pattern among free-living adults [12]

NUTRIENTS	BASIC	SD-1	SD-2	SD-3
Energy-KCAL	274	273.9	273	273
Protein-g	12	12.3	12.4	12.6
Fat-g	8.8	9.2	9.2	9.4
Calcium-mg	51	51.4	52	52.3
Magnesium-mg	72.5	77.4	82.3	87

## Cost analysis:

Cost of ingredients used for development of the the basic, Swast Dhokla-1, Swast Dhokla-2 and Swast Dhokla-3 was Rs 6.5, Rs 6.9 Rs 7.3 and Rs 7.7 respectively. With increase in the addition of oats and jowar the cost of the product also increased. However the cost of the most accepted variety SD-1 was similar to the basic.

#### Sensory evaluation:

Sensory attributes were evaluated for the basic and the three variations of Swast dhokla. The results of the sensorial attributes of basic against variations are discussed below. From this data, it was found that Swast dhokla-1 was the most accepted among all **Taste:** 

We value foods for its taste. It involves the perception of constituents after being detected by taste receptors in the taste buds found superficially on the tongue and other parts of the mouth.

The mean score of basic dhokla was 3.25, the mean score of swast dhokla -1 was 3.6, the mean score of swast dhokla 2 was 3.2 and the mean score of the swast dhokla 3 was 3.75. This shows that out of all the dhoklas the one in which complete substitution of rice was done with oats and jowar flour had better taste. We can attribute this due to the fact that the addition of oats and jowar give a more characteristic mild and nutty flavor.

These findings are in line with a study that demonstrated the high moisture retention properties of oat brings about improvements in cooking yield, and retentions of fat making them more juicer than control (p < 0.05) [13]. The FIGURE 2 below illustrates the average scores for taste of the basic and swast dhokla variaties.



FIGURE 2 Mean scores of taste for Basic Dhokla and Swast Dhokla (SD) variations

# **Texture:**

Texture is perceived by combination of senses that is touch, mouth feel, sight and hearing. It is one of the most imperative features of food. Texture is a prerequisite in the acceptance of numerous food stuffs, example, crispiness of biscuit and softness of bread, etc. It includes consistency, thickness, fragility, and chewiness of food.

The results for average score for texture here in this study showed that the swast dhokla, SD-1 had the highest average score of 3.9, followed by SD-2 and SD-3 with 3.58 and 3.5 respectively as seen in FIG 3. The texture of basic had lowest average score among all with 3.25. These results were in contrast with a similar study, wherein the sensory attribute of texture was highest for basic dhokla [14].

The increase in score for texture for the SD-1 could be due to texture improvement due to fermentation. Studies have demonstrated that fermentation of oats causes improvement in texture and flavor [15]. Further a study reported similarly a non-dairy fermented product based on oat [16]. The product named Adavena M40 was comparable to yoghurt and had high acceptability compared to control.



FIGURE 3 Mean scores of texture for Basic Dhokla and Swast dhokla (SD) variations

# Color:

Color is the primary indictaor of perceived quality. Assessment of initial quality of product is done by its colour and appearance. It is a cue for doneness of food and is correlated with aroma and flavor. Scientific studies have also shown that the color of the product affects our perception of other attributes [17]

For the color attribute the basic dhokla recveived the highest score with an average of 3.5 followed by SD-1 and SD-2 both with an average score of 3.4. SD-3 received the lowest score of 3.



FIGURE 4 Mean scores of color for Basic Dhokla and Swast Dhokla (SD) variations

## **Appearance:**

Surface characteristics of food products contribute to sensorial attribute of appearance. The highest mean score for appearance was for both basic dhokla and SD-2 with a score of 3.5. SD-1 received a mean score of 3.4. The mean score for SD-3 was 3.16 as shown in FIGURE 5. It was thus observed that with increase in the substitution of oats and jowar the appearance of the product becomes darker and less acceptable quality and acceptability of value added dhokla and basic dhokla had least difference.





## **Overall acceptability:**

Acceptability defines the experience of liking a food item. A study defined acceptance as "either: (i) an experience or feature of an experience characterized by a positive (e.g. approach in a pleasant) attitude; or (ii) actual utilization (e.g. purchase, eating)"[9]. The mean scores as illustrated in FIGURE 6 for overall acceptability were highest for swast dhokla-1 with 3.58 score. Basic dhokla had a mean score of 3.5 and SD-2 also had a mean score of 3.5. The SD-3 had a mean score of 3.4.



FIGURE 6 Mean scores of overall acceptability for Basic Dhokla and Swast Dhokla (SD) variations

# Statistical analysis:

TADIE	2	noired t test	hatwaan	hasia	dhalda	and	annoat	dhalda	1
IABLE	3	paired t-test	between	Dasic	апокіа	and	swast	unokia-	Т

S.no	Sensory attributes	Mean values of basic dhokla	Mean values of SD-1	t- value	Result
1	Taste	3.25	3.6	0.5	Insignificant
2	Texture	3.25	3.9		
3	Color	3.5	3.4		
4	Appearance	3.5	3.4		
5	Overall	3.5	3.58		
	acceptability				

Note: at critical value of t at p=0.05 is 3.18

# TABLE 4 paired t-test between basic dhokla and swast dhokla-2

S.no	Sensory attributes	Mean values of basic dhokla	Mean values of SD-2	t- value	Result
1	Taste	3	3.2	0.6	Insignificant
2	Texture	3.07	3.5		
3	Color	3.46	3.4		
4	Appearance	3	4		
5	Overall	3.3	4		r
	acceptability				

Note: at critical value of t at p=0.05 is 3.18

# TABLE 5 paired t-test between basic dhokla and swast dhokla-3

S.no	Sensory	Mean values of	Mean values of	t- value	Result			
	attributes	basic dhokla	SD-3					
1	Taste	3	4	0.9	Insignificant			
2	Texture	3.07	4					
3	Color	3.46	3					
4	Appearance	3	3.1					
5	Overall	3.3	3.4					
	acceptability							

Note: at critical value of t at p=0.05 is 3.18

The values that do not exceed the tabled value for the 5%, two-tailed limit on t, conclusion made is that there is insufficient evidence for a difference. In other words, The two samples were rather close, compared to the level of error among panelists. It can be said that the level of difference between the basic and the variations is very less, therefore the newly developed variations were similar to the basic and hence there is less chance of their rejection

# Nutrient analysis:

# Total dietary fibre estimation :

Data from the nutrient analysis indicated that the Swast dhokla-1 had 11.2 grams of fibre and basic dhokla was seen to have 8 g ram of fibre for 100 g of the product as presented in FIGURE 7. The addition of oats and jowar helped increase the fibre content by 3.2 gram. These findings are similar to study [18] where oats noodles at 20% and 30% substitution increased fibre content.





## Carbohydrate estimation:

Data from the nutrient analysis shows that the carbohydrate content of basic dhokla and swast dhokla-1 is 33.2 and 38.6 respectively. Fiber is a constituent part of carbohydrate, increase in fiber increases the carbohydrate content, typically refered as complex carbohydrate .This increase of carbohydrate, however cannot generate a high glycemic response similar to that of a refined carbohydrate or sugar source. A Study has demonstrated that high carbohydrate and high fibre diet increases peripheral insulin sensitivity [19].



#### **IV. CONCLUSION**

Dhokla is a vegetarian snack food item that is from the Indian state of Gujarat. It is made with a fermented batter made of rice and split chickpeas. Dhokla has a soft sponge like texture. It is savoury and has a hint of tanginess in taste owing to the fermentation. Value adding was done by replacing the rice with oats and Jowar flour and successfully developing a fermented dhokla that would be well accepted.

Dhokla here is used as a vehicle for introducing the use oats and jowar flour in everyday snack preparation. Compared to traditional option of rice or wheat, oats and jowar conatin beta glucan, and photochemicals (tannins and anthocyanin) respectively along with resistant starches that have been shown to help slower the release of sugars in the blood stream post absorption thereby positively affecting the blood sugar levels.

From the data examined from results and discussions it was concluded that variations from a basic dhokla using oats and jowar flour can be developed at 33%, 66% and 100% substitution of rice from the original recipe. Swast Dhokla-3 with 100% substitution was found to be superior in its nutrient content. The total cost for the ingredients of basic and variations was 6.5,6.9, 7.3 and 7.7 for basic SD-1,SD-2 and SD-3 respectively. Swast Dhokla-1 with 33% substitution was the most accepted in terms of its sensory qualities. The nutrient analysis revealed the fibre and carbohydrate content of basic and swast dhokla -1 was 8g, 33.2g and 11.2g and 38.6g respectively. Thus, this newly developed SD-1 had 3.2g more fibre, and required almost (+Rs0.4) the same cost for its production when compared the basic. The SD-1 and basic had little difference in terms other nutrients.

Therefore for a similar price healthy variation of dhokla with better fibre, and nutrient content having oats and jowar flour as functional ingredients can be made for diabetics.

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