Studies on Preparation of Low Calorie Cookies Using Maltodextrin as a Fat Replacer

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Abstract - In present investigation a study was conducted to develop low calorie food stuff like cookies using carbohydrate-based fat replacers. Attempts have made to replace fat in cookies by incorporation of pearl millet maltodextrin prepared by acid hydrolysis of pearl millet starch at different levels viz. 10, 20, and 30% (w/w) in the standard formulation. The influence of replacement of fat in cookie with maltodextrin in the formulation of cookies resulted in a significant change in the textural and sensory qualities of cookies. As the replacement level of fat with maltodextrin increased from 10 to 20% (w/w), the hardness and spread ratio was increased. Based on organoleptic evaluation it is recommended to adopt maltodextrin as fat replacer in cookies formulation upto the extent of 20 % (w/w) as it gives best results as compare to experimental control sample. Cookies prepared by replacing fat with maltodextrin upto the level of 20% was found to be more acceptable from sensory point of view and thereafter sensory score was reduced. Adding more maltodextrin decreased the level of calorie in the cookies.

Keywords – Cookies, Maltodextrin, Fat Replacer, Organoleptic, Sensory

I. INTRODUCTION

The growth of bakery industry is about 10% per annum and the products are increasingly becoming popular among all sections of people [1]. Snack food consumption has been on the increase as a result of urbanization and increase in the number of working women. Food based industry can exploit this development by fabricating nutritious snack foods. Cookies have become one of the most desirable snacks for both youth and elderly people due to their low manufacturing lost, more convenience, long shelf-life and ability to serve as a vehicle for important nutrients [2]. It is interesting to note that although cookies do not belong to the Indian traditional cuisine, they are ubiquitously present in all types of markets of India, which indicates the popularity of these products. Cookies are available in different unit packages in various flavors, shapes, sizes and with excellent organoleptic characteristics. Cookies and Biscuit is a baked products, commonly flour based food product. Baking is a cooking of food using prolonged dry heat acting by convection, rather than by thermal radiation, normally is an oven. The terms biscuits, cookies and crackers are almost synonymously used in India for the products prepared commercially using refined flour, hydrogenated fats and sugar along with emulsifiers and other additives. However, in the Western world 'biscuit' is small round bread leavened with baking powder or soda and the 'cookie' is small, flat baked treat, containing milk, flour, eggs, sugar and leavening agents. 'Cracker' is thin crisp wafer made of flour and water with or without leavening and shortening agents either unsweetened or semisweet [3].

Pearl Millet (*Pennisetum glaucum*), also known as Bajra, is a cereal crop grown in tropical semi- arid regions of the world primarily in Africa and Asia. Pearl millet is one of the four most important cereals (rice, maize, sorghum and millets) grown in the tropics and is rich in iron and zinc, contains high amount of antioxidants and these nutrients along with the antioxidants may be beneficial for the overall health and wellbeing [4]. Pearl millet can be grown on poor sandy soils in dry areas that are unsuitable for maize sorghum or finger millet [5]. Pearl millet is the most widely grown type of millet. Because of its tolerance to difficult growing conditions such as drought, low soil fertility and high temperature, it can be grown in areas where other cereal crops, such as maize (*Zea mays*) or wheat (*Triticum aestivum*), would not survive. Pearl millet production is concentrated in the developing countries which account for over 95% of the production and acreage. India continues to be the single largest producer of pearl millet in the world, although the area has been declining in the traditional growing states of Gujarat, Rajasthan and Haryana. Pearl millet

is usually grown as a dry land dual purpose grain and fodder crop although it is sometimes irrigated in India, particularly the summer crop grown mainly as a forage crop [6].

Starch is a polysaccharide carbohydrate consisting of a large number of glucose units joined together by glycosidic bonds. It comprises of amylose and amylopectin as it macromolecules. Starch is produced by all green plants as an energy store and is a important energy source for humans. It is found in potatoes, wheat, rice and other foods, and it varies in appearance, depending on its source [7]. Starch contributes greatly to the textural properties of various foods and has many industrial applications as a thickener, colloidal, stabilizer, gelling agent, bulking agent, water retention agent and adhesive. With increasing industrial demand for starches, there is a need to explore new and alternative sources of starch. In spite of the fact that the starch in the pearl millet represents 59 to 80% of the endosperm, however, pearl millet starches have been studied less extensively as compared to other conventional sources of cereal and tuber starches [8].

Maltodextrin '$(C_6H_{10}O_5)$ n.H_2O' is a mixture of saccharides with a molecular weight between polysaccharides and oligosaccharides with DE lower than 20 (not sweet), which is available as white powders mostly or concentrated solution. Maltodextrin is more soluble in water than native starches, also is cheaper in comparison with other major edible hydrocolloids and its solutions have a bland flavour and smooth mouthfeel. Maltodextrin as a food additive has been applied for about 35 years. It performs multifaceted functions in food systems, including bulking, caking resistance, texture and body improvement, films formation, binding of flavour and fat, serving as oxygen barriers, aiding to dispersion and solubility, increasing of soluble solids, crystallization inhibition and control of freezing point, fillings and as product extenders. Maltodextrin has been studied as a plasticizer to reduce glass transition temperature in materials. It has been proven useful to reduce Maillard reactions and is used in microencapsulation of food components such as vitamins, minerals and colourants [9].

II. MATERIALS AND METHODS

A. Materials

a. Procurement of raw material

Good quality raw materials such as refined wheat flour, powdered sugar, butter, baking powder, essence and pearl millet were procured from local market of Aurangabad which was used for making cookies. Various chemicals and instruments used were obtained from Department of Agricultural Engineering Maharashtra Institute of Technology, Aurangabad.

B. Methods

a. Extraction of Starch

Starch was extracted by using the wet process method. Pearl Millet grain (100 g) was steeped in 200 ml of NaOH (0.25% w/v) at 5°C for 24 hrs. The steeped grains were washed and ground with an equal volume of water using a blender for 3 min. The slurry was filtered through a 200-mesh screen. The residue on the sieve was rinsed with water. Grinding and filtering were repeated thrice on this material. After rinsing, residue was discarded. The filtrate was allowed to stand for 1 hr. The filtrate was centrifuged at 6000 rpm. for 10 min. The grey colored, top protein-rich layer was removed using a spatula. Excess water was added to resuspend the sample, and centrifugation was done again for 5 min. washing and centrifugation were repeated several times until the top starch layer was white. The starch was dried for 24 hrs at 40°C. Percentage recovery was determined on the basis of 100 gm sample [10].

b. Preparation of Maltodextrin

Starch extracted from Pearl Millet (*Bajra*) was utilized for the preparation of maltodextrin using acid hydrolysis by Hydrochloric acid (HCL). The acid hydrolysis was done at 0.3 per cent for 60 min [11].

c. Preparation of cookies

Traditional creaming method was used for the preparation of cookies and the process was standardized. The flow chart for preparation of cookies is given in Figure 2.

d. Experimental design

Based on review of literature and preliminary trials, the experimental work plan was prepared and experimental parameters were identified. The detailed work plan, treatment variables and experimental design are given below.

Table 1: Standard Recipe for Formulation of Cookies

Sr. No.	Ingredients	Treatments			
		T_0	T_1	T_2	T_3
1.	Fat : Maltodextrin	100	90:10	80:20	70:30
2.	Sugar	50	50	50	50
3.	Flour	100	100	100	100

Flow sheet for cookies

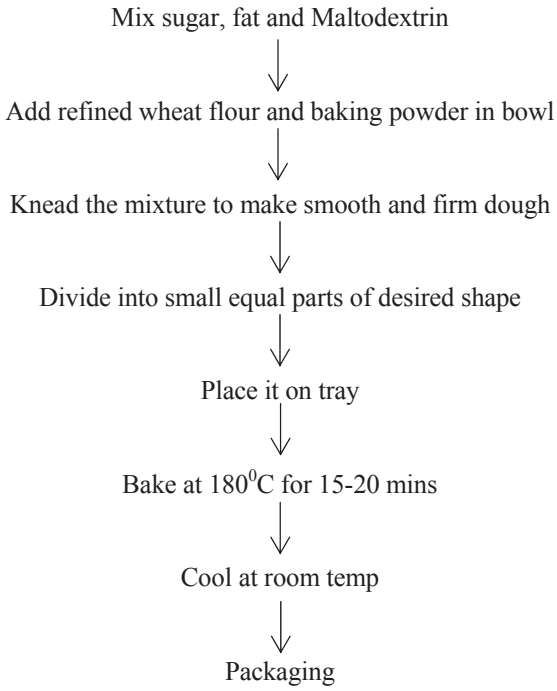

Figure 1: Flow Chart for Preparation of Cookies

III. EXPERIMETS AND RESULTS

The experiments were conducted for "Studies on preparation of low calorie cookies using maltodextrin as a fat replacer". The present investigation was under taken to evaluate the quality as well as acceptability of utilization of maltodextrin for the preparation cookies.

The results obtained during the present investigation are presented and discussed under suitable heading. The results were discussed in the view of relevant scientific literature available in the country and elsewhere.

a. Chemical Analysis of Cookies

Chemical composition of maltodextrin incorporated cookies were determined and tabulated in Table 2.

Table 2: Chemical Analysis of Cookies

Parameters	Level of Maltodextrin			
	0 %	10 %	20 %	30 %
Moisture %	2.16	2.46	2.61	2.78
Ash %	0.56	0.56	0.57	0.58
Fat %	28.82	25.26	22.67	18.18
Protein %	6.14	6.12	6.13	6.15
Crude fibre %	1.85	1.82	1.83	1.82
Total carbohydrate %	60.47	63.78	66.19	70.49
Calories (Kcal)	482.09	450.63	429.39	418.33

*- Each value was an average of three determinations.

The change occurred in calorific value with respect to percent increased in maltodextrin is represented in figure 2. From the figure it is clear that the considerable decreased in calorie was observed with increase in maltodextrin level.

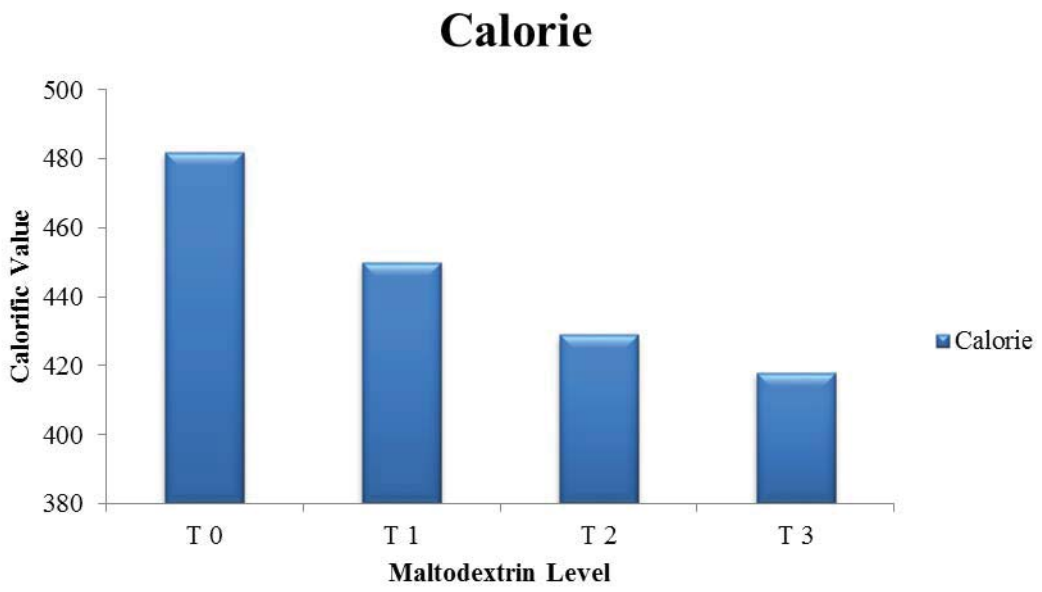

Figure 2: Calories in Fat replaced cookies

(Note: The calories content is lowest in T3 i.e. 418.33 kcal/100g as compare to control cookies 482.09 kcal/100gm.

The chemical assessment of control and maltodextrin incorporated cookies is given in Table 2. The moisture of all the maltodextrin incorporated cookies was found to be slightly greater than control cookies. The reason behind the same was maltodextrin incorporated dough required excess water than the control dough. The ash content was slightly increased in maltodextrin incorporated cookies. All the maltodextrin incorporated cookies had protein content likewise control cookies ranging from 6.12 % to 6.15 %. Also it was observed that the fat content decreased as increase in the level of maltodextrin. As fat was replaced by maltodextrin therefore it was observed that maltodextrin incorporated cookies contain lower fat content than the control cookies. Crude fibre content of cookies was ranging from 1.85 % to 1.82 %. Carbohydrate content was increased slightly as increased in maltodextrin incorporation. All the maltodextrin incorporated cookies were found to contain lesser calorie than control as maltodextrin had fewer calories than fat.

b. Sensory Evaluation

The following table shows that sensory score of cookies. Overall acceptability of prepared cookies was defined by sensory evaluation which was performed by fifteen number of semi- trained panelist. The accepted the level of maltodextrin incorporated cookies was 20%. Data about the sensory evaluation for appearance, colour, flavor, texture and overall acceptability of cookies are summarized in Table 3.

Table 3: Effect of Different Level of Maltodextrin on Sensory Characteristics of Cookies

Parameters	**Level of Maltodextrin**			
	0 %	**10 %**	**20 %**	**30 %**
Colour	8.3	7.5	7.2	7.1
Flavour	8.0	7.3	7.5	6.8
Taste	8.2	7.6	7.2	6.3
Texture	7.6	7.3	7.2	7.5
Overall Acceptability	8.3	7.5	7.3	6.7

The score of colour reduced significantly for incorporation level 10 % and above. All maltodextrin incorporated cookies had less sensory score for flavor than the control cookies. Sensory score for flavor for maltodextrin incorporated cookies was observed in range from 7.5 to 6.8. The significant difference in colour was found at the level of 10 and above. The texture of maltodextrin incorporated cookies was slightly harder than control which resulted less score for texture as compare to control for incorporation level 20 % and above. Development of roughness was observed on the surface of incorporated cookies for incorporation level of 20 % and above and was the cause of poor appearance. Overall acceptability of decreased as maltodextrin incorporation level increased. The sensory score of control and all the maltodextrin incorporated cookies for overall acceptability is expressed in figure 3. On the basis of sensory evaluation (overall acceptability) the maximum level of maltodextrin to be incorporated was found to be 20 %.

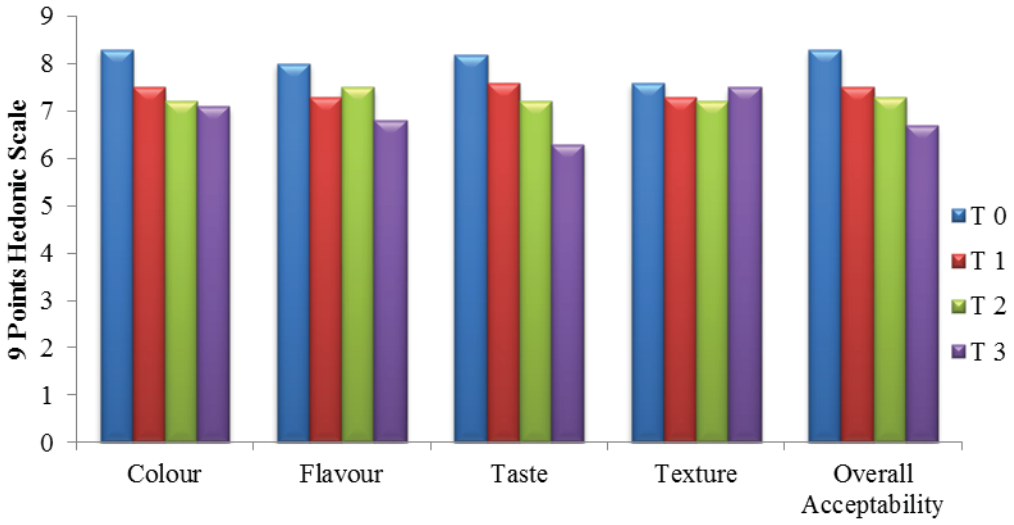

Figure 3: Effect of different level of maltodextrin incorporation on sensory characteristics of cookies

IV.CONCLUSION

Thus, it may be concluded that Maltodextrin prepared from pearl millet starch can be successfully incorporated in the formulation of cookies to reduce the calories by replacing the fat. Low calories cookies of acceptable quality can be prepared by incorporating maximum 20% maltodextrin in the formulation of cookies without affecting the overall quality. The calorific value of cookies decreases as the incorporation level of maltodextrin increases.

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