



Research paper

Process Development of Ready-to-Fry Gluten Free Vegetable Nuggets

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KEYWORDS

Gluten free
Deep-fried
Quick frozen
Celiac disease

ABSTRACT

Present study was carried out to prepare gluten free vegetable nuggets as Commercial nuggets are traditionally coated with wheat flour, deep-fried and quick frozen. However, fried foods absorb oil during frying, which is a health concern as excessive lipid consumption can contribute to obesity and heart disease. Wheat Gluten, ingestion causes health problems in people who suffer from celiac disease. The nutritional value of potato, gluten free nature of rice flour provides alternative to wheat flour for use in food products and has been utilized in batters to coat foods for frying in specialty products. Use of rice flour batters absorb and retain less oil during frying than wheat flour batters. Oats have soluble fiber, polyphenols & avenanthramides (antioxidants) and bioactive compounds that may provide health benefits. Gluten removal results in major problems for bakers, and currently, many gluten-free products available in the market are of low quality, exhibiting poor mouth feel and flavor. In this study the optimization of Vegetables for Stuffing, Spices in Stuffing, Coating with Rice Flour Slurry and oats in Single layer coating and double layer was carried out. Optimization has been carried out based on sensorial analysis and product was formulated. Proximate analysis, TPC and storage period of prepared product was studied.

1. Introduction

The demand for ready-to-fry *convenient* food items is increasing continuously in the present-day liberalized economy mainly due to improved living standards, urbanization growth, preference of new generation for fast foods, rise in per capita income and increase in the number of workingwomen preferring ready cooked food (S.K. Pandey et al., 2009). Quality and safety of frozen snack foods are the aspects affecting the overall consumer acceptability in terms of flavour, aroma, colour and appearance besides nutritional quality (Torres and Canet,). Generally frozen ready-to-eat snack food is consumed with no or little further processing except



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reheating. These frozen vegetable snacks can directly be fried in oil without thawing after frozen storage (Maity, T et al., 2012). Commercial nuggets are traditionally coated with wheat flour, deep-fried and quick frozen (Jackson, V et al., 2016). However, fried foods absorb oil during frying, which is a health concern as excessive lipid consumption can contribute to obesity and heart disease (Filip, S et al., 2012). Individuals affected by Celiac Disease are unable to consume food products containing wheat flour as gluten causes atrophy of the villi in the small intestine, therefore diminishing the absorptive area of the intestine and resulting in malabsorption of carbohydrates, fat, vitamins and minerals (García-Manzanares, Á et al., 2011). The potato is a carbohydrate-rich, energy providing food. Development of Ready-To-Fry Gluten Free Vegetable Nuggets with little fat. Protein content of potato is fairly low but has an excellent biological value of 90–100. Potatoes are particularly high in vitamin C and are a good source of several B vitamins and potassium. (Camire, M. E., et al., 2009). The importance of potatoes in various countries because of them contains a wide range of vital nutrients such as low fatty contents, minerals and vitamins. It is a higher source of ascorbic acid, vitamin B6, vitamin B9, vitamin B1 and both micro minerals and micro minerals (including potassium, iron, copper, manganese, phosphorus). Rice flour is an alternative to wheat flour for use in food products and has been utilized in batters to coat foods for frying in specialty products (Shih and Daigle et al.,) but has not entered the mainstream portion of the grocery store or foodservice industry. Chemical composition of rice differs from wheat that causes rice flour batters to absorb and retain less oil during frying than wheat flour batters. (V. JACKSON., et al., 2016). Oats have earned the title of a “Super grain” because of the health benefits they provide. In addition to soluble fiber, polyphenols & avenanthramides (antioxidants), oats and oat products have many bioactive compounds that may provide health benefits. Oats and oat containing products that meet a minimum level of oat beta-glucan are allowed to bear a FDA approved health claim for cholesterol-lowering benefits (Khanna P., Mohan S., 2016). Potential dietary fiber sources from various cereals, legumes, fruits and vegetables could be used as functional ingredients in meat products by judicious processing methods (Santhi D et al., 2014).

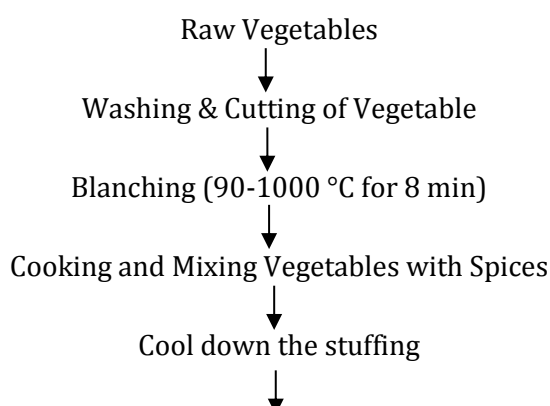
Gluten is widely used in food processing and gluten contamination during the process of industrialized food production is of frequent occurrence (Falcomer, A. et al., 2020). Because these foods have poor elasticity due to the absence of gluten, other specific components are added, often resulting in increased content of fat and starch, i.e., higher in calories in comparison with their gluten-containing counterparts. Gluten removal results in major problems for bakers, and currently, many gluten-free products available on the market are of low quality, exhibiting poor mouth feel and flavor (Arendt, et al., 2004). Compliance to a gluten-free diet results in symptom remission, histological and functional recovery of the small intestinal mucosa, and decreased risk of complications (Simón, E et al., 2023). This presents a major challenge to the cereal technologist and baker alike, and has led to the search for alternatives to gluten in the manufacture of gluten-free bakery products.

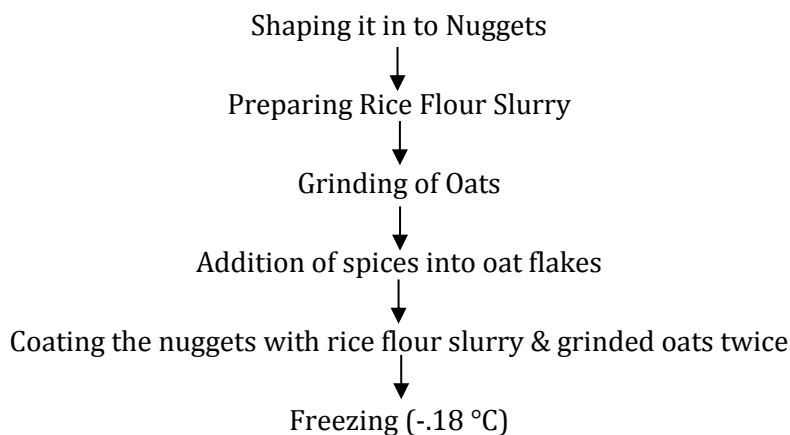
2. Materials and Methods

2.1 Raw Materials, chemicals, Utensils and Equipment's and instruments were procured from Food Technology laboratory of Department of Technology, Shivaji University, and Kolhapur.

2.2 Methodology

2.2.1 Process flow sheet





Development of ready-to-fry frozen vegetable snack and its quality evaluation (Maity, T., Shah, A., Raju, P. S., & Bawa, A. S. (2012) (with slight modification)

2.2.2 Formulation of Control sample

Table 1 Formulation of Control sample

Ingredients	Quantity (%)
Stuffing	30
Corn starch	20
Bread crumbs	50

Control sample was formulated similar to that which is available in market, to conduct the Comparative sensory analysis.

2.2.3 Optimization of Vegetables for Stuffing

Table 2 Optimization of Vegetables for Stuffing

Ingredients	T1 (%)	T2 (%)	T3 (%)	T4 (%)
Potato	80	60	40	20
Capsicum	10	20	30	40
Green peas	10	20	30	40

Optimization of vegetables for nugget stuffing was carried out. Four samples i.e T1, T2, T3 and T4 were taken with different proportions of potatoes, capsicum and green peas. T1 was selected on the basis of sensory analysis.

2.2.4 Optimization of Spices for Stuffing

Table 3 Optimization of Spices for Stuffing

Ingredients	T1 (%)	T2 (%)	T3 (%)
Spice mix	50	40	60
Chili powder	50	60	40

Optimization of spices for the vegetable stuffing was carried out. Three samples T1, T2 and T3 were taken with different proportions of spice mix and red chilli powder. T3 was selected on the basis of sensory analysis

2.2.5 Optimization of Coating

Table 4 Optimization of Coating

Ingredients	T1 (%)	T1 (%)	T2 (%)
Rice Flour Slurry	10	20	30
Oats (crumbs)	90	80	30

T1-Single layer coating, T2-Double layer coating

Optimization of oats and rice slurry for nuggets coating was carried out. Two samples T1 and T2 were taken with single and double coating layer. Sample T1 was selected on the basis of sensory analysis

2.2.6 Formulation of Final Product

Table 5 Formulation of Final Product

Ingredients	Quantity(gm)
Rice Flour	6.5
Potato	52.09
Oats	22.7
Capsicum	6.5
Peas	2.2
Spices	2.2
Oil	7.81

From the above optimization process sample was formulated

3. Results and Discussion

3.1 Analysis of Raw materials

Table 6 Analysis of Raw materials

Ingredient	Moisture (%)	Ash (%)	Carbohydrate (%)	Protein (%)	Fat (%)
Rice Flour	11.33	0.8	79.06	7.89	0.92
Oat	4.20	1.97	55.75	12.62	6.91
Potato	72.21	0.9	25.77	1.02	0.1

Table 6 illustrates the proximate analysis of the raw materials, detailing its composition in terms of moisture, ash, protein, fat, and carbohydrates.

3.2 Optimization of vegetable for stuffing

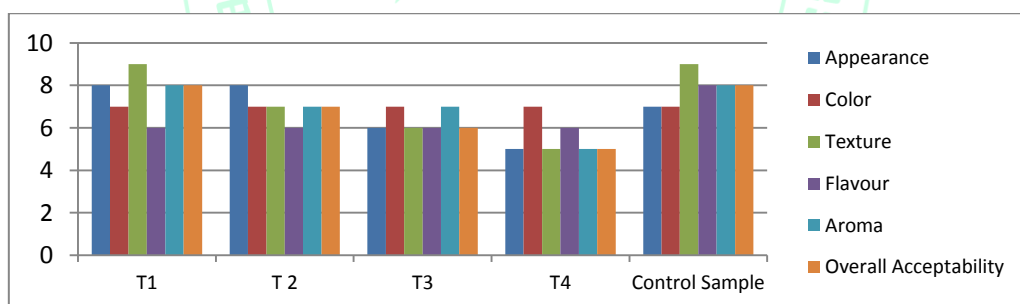


Fig. 2 Sensory Analysis of Vegetable stuffing

Figure number 2 shows the optimization of vegetable for stuffing. It can be concluded that the sample **T1** has received good sensory score in terms of appearance, color, texture, flavor, aroma and overall acceptability. Control sample showed similar score as that of Sample **T1**.

3.3 Optimization of Spices for stuffing

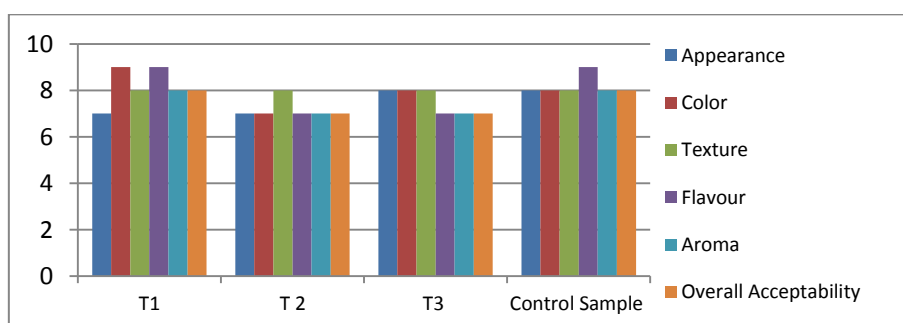


Fig. 3 Sensory Analysis of spices for stuffing

Figure 3 shows the optimization of Spices for stuffing. It can be concluded that the sample **T1** has received good sensory score in terms of appearance, color, texture, flavor, aroma and overall acceptability. Control sample showed similar score as that of Sample **T1**.

3.4 Optimization of Coating

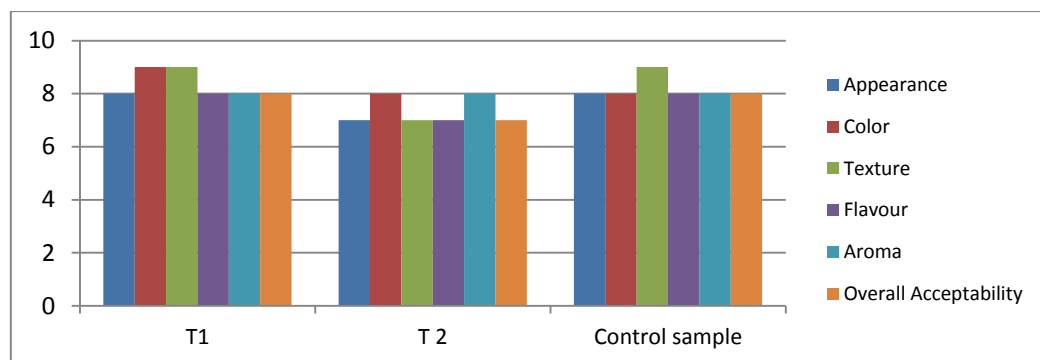


Fig. 4 Sensory Analysis of Coating

Figure number 3 shows the optimization of Coating. It can be concluded that the sample **T1** has received good sensory score in terms of appearance, color, texture, flavor, aroma and overall acceptability. Control sample showed similar score as that of Sample **T1**.

3.5 Proximate Analysis of Final Product

Table 7 Proximate analysis of Final Product

Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)
68.70	3.13	1.39	1.59	25.24

Table 7 illustrates the proximate analysis of the formulated sample, detailing its composition in terms of moisture, ash, protein, fat, and carbohydrates. The moisture content was found to be 68.70%. Similarly Protein, Fat, Ash and Carbohydrate were found to be 3.13%, 1.39%, 1.59% and 25.24% respectively.

3.6 Total Plate Count

Table 8 Total Plate Count

Parameter	0 day	1day	2 day	3 day	4 day	5 day	6 day	7 day
Control Sample	2.1×10^{-2}	2.2×10^{-2}	2.3×10^{-2}	2.8×10^{-3} (Spoiled)	ND	ND	ND	ND
T1	2.0×10^{-2}	2.1×10^{-2}	2.3×10^{-2}	2.9×10^{-3} (Spoiled)	ND	ND	ND	ND
T2	2.0×10^{-2}	2.1×10^{-2}	2.3×10^{-2}	2.8×10^{-3} (Spoiled)	ND	ND	ND	ND

* ND-Not Defined

Total Plate Count was studied upto 7 days (Table 8). It was found that the formulated sample had permissible microbial growth till 3rd Day. Further microbial growth proceeded rigorously which could not be defined. Hence it can be concluded that the formulated sample have a shelf life of 3 days at room temperature.

4. Conclusion

This project work aimed to develop Ready-To-Fry Gluten-Free Vegetable Nuggets and to improve its nutritional quality. Gluten-Free Vegetable Nuggets were prepared from a combination of Vegetables including Potato, Capsicum, and Green Peas. The vegetables were semi-cooked mixed together along with the spices and shaped into nuggets. The nuggets were coated in the Rice Flour Slurry and Oats subsequently and spices were added to achieve the desired taste that drives attention for more acceptance. The nuggets were coated and stored in deep freezer at -18 °C. The proximate assessment of the developed RTF gluten-free vegetable nuggets was

carried out. The proximate analysis shows that prepared nuggets contain 68.70% moisture, 3.13% protein, 1.39% fat, 1.59% ash and 25.24% carbohydrate. The energy value was found to be 125.99 Kcal. Gluten-Free Vegetable Nuggets are rich in carbohydrate (25%), good source of fiber and contains some amounts of vitamins and minerals. Microbiological analysis shows that up to 3 rd day there was no growth of Colony and after that it varied significantly. These newly developed gluten-free vegetable nuggets have the potential to be marketed as a ready-to-fry snack and it would also help food manufacturers and processors in new product development area of gluten free vegetable nuggets.

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Declaration of Conflict

We have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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