



## Formulation and evaluation of fibre enriched rusks

S.Thilakavathy\* and Kavya.S

Department of Food Science and Nutrition, Avinashilingam Deemed University for Women, Coimbatore.

### ARTICLE INFO

#### Article history:

Received: 29 July 2013;

Received in revised form:

2 October 2013;

Accepted: 19 October 2013;

#### Keywords

Traditional diets,  
Industrialised foods  
Functional foods,  
Baked products,  
Vegetable powders  
Incorporation,  
Dietary fibre,  
Formulation,  
Glycemic index,  
French beans-evaluation.

### ABSTRACT

There is a decline in the intake of fruit and vegetables and the diets have shifted toward more sugars and fats, due to urbanization. Vegetables being a rich source of soluble and insoluble fibres can be incorporated in various food products to improve the functional properties of these products. Bakery products are consumed by a wide range of population and hence bakery products, such as bread, biscuits, rusks and cookies serve as a vehicle for the incorporation of functional foods and dietary fibre. Vegetables such as broad beans, cluster beans and French beans rich in dietary fibre were selected and processed to prepare dry powder. This powder was incorporated in the bakery product rusk at 10%, 20%, and 30% level to the standard rusk recipe. The rusks were prepared separately using broad beans, cluster beans and French beans powder. The rusk biscuits were then organoleptically evaluated for the acceptability. Nutrient analysis was carried out for the standard and the fibre incorporated rusk that were selected after sensory evaluation. The glycemic index of the formulated rusk was determined to check if the fibre incorporated, reduced the glycemic load of the rusk. The study revealed that 10 percent level of incorporation of the different vegetable powders was found to be acceptable. The crude and dietary fibre content increased in the formulated rusk. The glycemic index of the beans powder incorporated rusk was less when compared with the standard rusk.

© 2013 Elixir All rights reserved

### Introduction

Fruits and vegetables are important components of a healthy diet, and daily consumption of sufficient fruits and vegetables could help prevent major diseases such as cardiovascular diseases and certain cancers. Approximately 1.7 million (2.8%) of deaths worldwide are attributable to low fruit and vegetable consumption<sup>2</sup>. Increased dietary fiber consumption is associated with multiple health benefits. Fruits and vegetables are associated with lower risk of heart disease by lowering total and LDL blood cholesterol levels. Dietary fiber is also important for digestive health, it is essential for laxation and intestinal regularity<sup>3</sup>.

Due to urbanization there is a decline in the intake of fruit and vegetables and the diets have shifted towards more sugars and fats, less fruit and fewer vegetables. There is no evidence of a substantial shift of average diets towards nutritive and protective foods. Vegetables being a rich source of soluble and insoluble fibres can be incorporated in various food products to improve the functional properties of these products.

The demand of bakery products is increasing at the rate of 10.07% per annum. India is a developing country with large segment of population depending on wheat as staple foods and 25% of wheat is used in the preparation of baked foods. Bakery products are consumed by a wide range of population and hence such as bread, biscuits, rusks and cookies. Due to changing life style the people have started demanding ready to cook or ready to serve convenience foods. More and more women are seeking employment to supplement the family income and they find less time for cooking and therefore demand ready to serve foods. Baked products are considered as excellent vehicle for fortification, value addition and feeding at mass scale<sup>4</sup>.

Hence under these circumstances the present study "Formulation and Evaluation of fibre enriched rusk" has been undertaken with the following objectives to:

1. Conduct socio-economic and dietary survey among adults to study the fibre consumption pattern.
2. Formulate and evaluate rusk incorporated with different combinations of vegetable powders.
3. Estimate the nutrient content of the fibre enriched rusks.
4. Analyze the microbial load of the fibre enriched rusks.
5. Determine the glycemic index of the fibre enriched rusks.

### Experimental Procedure

The area chosen for the conduct of the study was Coimbatore city in Tamil Nadu state. A total of 100 adult men and women in the age group of 20 and 60 years were interviewed during the household survey. An Interview schedule was developed by the investigator for the survey to collect data about their socio economic status, life style, dietary and fibre consumption pattern. Information regarding their personal health and life style pattern was also asked in the interview. From the data obtained regarding the fibre consumption the vegetables for the formulation of fibre enriched Rusk were selected.

The selected vegetables were balanced in luke warm water, cut into thin strips and then dried in a microwave oven at 60°C for 10-15 mins. The dried vegetables were then powdered in a mixer and packed in air tight containers. Fruit and vegetables are important components of a healthy diet, and their sufficient daily consumption could help prevent major diseases, such as cardiovascular diseases and certain cancers. Low fruit and vegetable intake is among the top 10 risk factors contributing to attributable mortality, according to evidence presented in World Health Report 2008.

- i. A penetrating quality that leads to the uniform drying.

Tele:

E-mail addresses: [thilaka.ravichandran@gmail.com](mailto:thilaka.ravichandran@gmail.com)

© 2013 Elixir All rights reserved

- ii. Selective absorption by liquid water, which leads to uniform moisture profile within the particle.
- iii. Case of control due to rapid response of such heating.

The blanched vegetable pieces were arranged on drying trays as a single layer and dried in a Microwave oven at 60° C for 10-15 min. The dried vegetables were then powdered in a mixer, sieved and packed in air tight containers to prevent contamination of the powders by air, dust and micro organisms.

#### **Incorporation of vegetable powders into Standard rusk recipe:**

Modern nutritional science has been laying stress on important role of dietary fiber in health protection and prevention of modern diseases and on necessity of every day intake of dietary fibres through food, since the last decade. (Flammang *et al.* 2006). According to Sudha *et al.*, (2007), bakery products are sometimes used as a vehicle for incorporation of different nutritionally rich ingredients. Confectionery industry has been increasingly engaged in production of fibre enriched biscuits with the aim to offer such product as a valuable constituent of good nutrition and dietetic functional food intended for risky populations.

Bakery products are considered to be important for a balanced and nutritious diet since they are rich in carbohydrate, which offer the essential energy and several important B complex vitamins, vitamin E, minerals (calcium and iron) and dietary fibre for human body functions (Da-Wen Sun, 2012). For the present study Rusk was selected for the incorporation of vegetable fibre, as rusk is one of the bakery product that is prepared with low amount of fat and sugar. Rusks are well accepted among different age groups and acts a vehicle for the incorporation of functional foods. The rusks were prepared using a standard rusk recipe. The vegetable powders were incorporated at 10%, 20%, 30% level to recipe. The rusks were prepared separately using broad beans, cluster beans and french beans powders.

**Table I Proportions Of Vegetable Powder Incorporated In Rusk Biscuits**

S.No	Ingredients	S	V1	V2	V3
1.	Maida	250g	225g	200g	175g
2.	Dry Yeast	5g	5g	5g	5g
3.	Sugar	50g	50g	50g	50g
4.	Oil	50g	50g	5g	50g
5.	Vegetable Powder	-	25g	50g	75g

S-Standard; V- Variation; V1- Variation 1 -10 % Vegetable powder;

V2- Variation 2- 20% Vegetable powder; V3- Variation 3- 30% Vegetable powder

#### **Sensory Evaluation**

Sensory properties, among many other factors, influence considerably the quality of food products. A product could have an excellent composition and satisfy the highest nutrition criteria, but if it is unsatisfactory in appearance, taste or odour it will not find the way to consumers. Sensory evaluation has been defined as a scientific method used to evoke, measure, analyze and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing (Heyman, 2010).

The rusk biscuits were organoleptically evaluated by 10 panel members. To avoid errors due to physical, physiological, environmental and individual characteristics, panel of evaluators were used rather than a single assessor. The panel members were selected on the basis of their age, health, cooperation, willingness and knowledge of sensory analysis and also the ability to discriminate the various criteria's for sensory

evaluation. Score Card is a tool which help in evaluation through direction and degree of judgement using suitable defined scores (Manay and Shadaksharaswamy, 2007). A Five Point Hedonic Scale was developed for the purpose of evaluation of the appearance, flavor, texture, taste and overall acceptability as given in Annexure II. The Sensory Evaluation was carried out in a suitable time around 11am to 12pm, before lunch time. The results were recorded and analyzed appropriately.

#### **Phase III: Evaluation of Fibre Enriched Rusk**

##### **Nutrient Analysis:**

Analysis of nutrient content is an important aspect in formulating and developing new product and evaluating new process for making food products and identifying the sources of problem with unacceptable problem (Nielson, 2006). Adequate analytical methods for nutrients in foods, food ingredients, and food products are the basic first step in determining the nutritional adequacy of a food supply. Whatever the ultimate use of nutrition data, i.e. consumer education via the food label, or databases for nutrient and deficiency disease studies, the assay used to provide the data must determine the analyte of interest adequately (Jonathan, 2007).

Nutrient analysis was carried out for the standard and the fibre incorporated rusk that were selected after sensory evaluation. The nutrients that were analyzed in these samples include all the proximate nutrients such as Energy, Protein, Fat, Carbohydrate, Crude Fibre, Moisture and ash. The samples were also analyzed for the total dietary fibre content. AOAC (The Association of Official Analytical Chemists)<sup>5</sup> International Methods were used for determining the nutrient content of the product. Shelf life is most influenced by several factors: exposure to light and heat, transmission of gases, humidity, mechanical stresses, and contamination by micro-organisms. Microbiological analysis is important to determine the safety and quality of food. Microbial analysis was carried for the standard and the selected samples. The samples were stored in air tight and zip lock covers. The microbial content of the sample was estimated for the first week.

In order to check if the formulated rusk can be consumed by diabetic individuals, the glyceemic index of the selected rusks was determined.

#### **Results and Discussion**

##### **Background details**

The socio-economic survey revealed that 39 percent of adults belonged to the age group of 30-40 years and sixty percent of the adults belonged to high income group earning more than Rs.10,000 per month. Nearly 60 percent of the adults spent less than 50 percent of the income on food. With regard to health history 58 percent of the adults under took regular health check up. In concern to the prevalence of health complications 28 percent of the adults were obese, 27 percent had diabetes, 22 percent had hypertension and 28 percent had osteoporosis. Eighty four percent had the habit of exercising regularly and walking was the common exercise performed.

##### **Dietary pattern**

Sixty four percent of the adults identified for the study were non-vegetarians. The food frequency questionnaire revealed that seventy three percent of the adults consumed rice daily. Thirty three percent consumed wheat flour on a daily basis. Among pulses black gram dal was consumed most frequently. Green leafy vegetables were mostly consumed once a week. Roots and tubers were consumed once a week or biweekly. Onion (big) was consumed on a daily basis by all the adults.

**Table II**  
**Frequency of Consumption of Fibre – Rich Foods**

Fibre rich foods	Daily		Thrice a week		Twice a week		Once a week		Once in 15 days		Once a month		Occasionally	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Whole Wheat flour	33	33	20	20	22	22	15	15	7	7	2	2	1	1
Ragi	22	22	8	8	13	13	12	12	8	8	12	12	25	25
Leafy vegetables	8	8	13	13	23	23	28	28	18	18	9	9	1	1
Beans	4	4	8	8	7	7	23	23	15	15	31	31	12	12
Fruits	27	27	12	12	20	20	32	32	9	9	0	0	0	0

**Table III**  
**Mean Acceptability Scores For Vegetable Powder**

Attributes	Colour	Flavour	Texture	Taste	Overall acceptability
Broad bean powder					
S	4.9 ±0.32	5±0	5±0	4.7±0.48	4.9±0.32
B <sub>1</sub>	3.7±0.48	4.6±0.52	4.8±0.42	4.4±0.52	4.3±0.48
B <sub>2</sub>	3±0.47	3.9±0.32	3.9±0.32	3.7±0.48	3.7±0.48
B <sub>3</sub>	2±0.48	2.8±0.42	2.7±0.67	2.6±0.52	2.6±0.52
Cluster beans powder					
S	4.9±0.32	5±0	5±0	4.7±0.48	4.9±0.32
C <sub>1</sub>	3.6±0.52	4.7±0.48	4.7±0.48	4.7±0.48	4.3±0.48
C <sub>2</sub>	3.2±0.42	3.5±0.85	3.5±0.48	3.2±0.42	3.5±0.53
C <sub>3</sub>	2.4±0.52	2.8±0.42	2.7±0.48	2.5±0.52	2.8±0.74
French Beans powder					
S	4.9±0.32	5±0	5±0	4.7±0.48	4.9±0.32
C <sub>1</sub>	3.5±0.53	4.8±0.42	4.8±0.42	4.7±0.48	4.3±0.42
C <sub>2</sub>	3.2±0.42	3.7±0.48	3.8±0.43	3.2±0.42	3.4±0.52
C <sub>3</sub>	2.2±0.42	2.7±0.47	2.6±0.52	2.5±0.52	2.8±0.52

**Table IV**  
**Nutrient Analysis Of The Fibre Enriched Rusk**

Nutrients	Standard	Broad beans	Cluster beans	French beans
Energy (k Cal)	395	378.5	383.6	382.7
Protein (g)	9.4	9.7	9.6	9.6
Total fat (g)	5.2	5.2	5.1	5.2
Carbohydrate (g)	77.5	73.7	75.1	75.8
Moisture (g)	3.02	2.8	2.7	2.6
Ash (g)	2.4	3.9	3.5	3.7
Crude Fiber (g)	0.5	2.9	2.3	2.1
Total Dietary Fibre(g)	1.5	3.1	2.8	2.6

Other vegetables were consumed once a week and once in 15 days. Among nuts and oil seeds coconut (fresh) was consumed daily by 23 percent. Thirty nine percent of the adults consumed banana every day. Tomato was consumed on daily basis by all the adults. Forty two percent of the adults consumed egg twice a week. Milk and cooking oil was consumed daily by all the adults. Table II illustrates the frequency of consumption of fibre rich foods.

Table III presents the data for the mean acceptability scores for vegetable powder incorporated rusk.

Table IV gives the details about the nutrient analysis of the fibre enriched rusk.

Nutrient analysis revealed that protein content of the fibre enriched rusks was 9.4g, 9.7g, 9.6g and 9.6g for standard, 10 percent broad beans, cluster beans and French beans powder incorporated rusk respectively. The fat content of the standard was found to be 5.2g per 100g of the sample. The fat content of 10% broad beans powder, 10% cluster beans powder and 10% French beans powder incorporated rusks was found to be 5.2g, 5.1g and 5.2g per 100g of the sample respectively. The carbohydrate content in the standard rusk was found to be 77.5 g per 100g of the sample.

The carbohydrate content of 10% broad beans, 10% cluster beans and 10% French beans powder incorporated rusk was found to be 73.7g, 75.1g and 75.8g respectively. The moisture content to the standard was found to be 3.02g for 100g of the sample. The moisture content of 10% broad beans, cluster beans and French beans powder incorporated rusk was found to be 2.8g, 2.67g and 2.6g respectively.

The ash content of the standard was found to be 2.4g per 100g of the sample. The ash content of 10% broad beans, cluster beans and French beans powder incorporated rusk was found to be 3.9g, 3.5g and 3.7g per 100g of the sample respectively. The crude fibre and dietary fibre content of standard was found to be 0.5g per 100g of the sample respectively. The crude fibre of 10% broad beans, cluster beans and French beans powder incorporated rusk was found to be 2.9g, 2.3 g and 2.1 g respectively. The dietary fibre content to standard was found and 1.5g per 100g of the sample respectively. The dietary fibre of 10% broad, cluster beans and French beans powder incorporated rusk was found to be 3.1g, 2.8g and 2.6g respectively.

### Microbial analysis

The standard rusk along with the 10 percent broad beans powder, 10 percent cluster beans powder and 10 percent French beans powder incorporated rusk was analyzed for its total bacterial and fungal count once in a week for three consecutive weeks. All the samples were found to be acceptable during the first week and the second week. In the third week the samples stored in the air tight container were found to be acceptable while the samples stored in the zip lock cover showed a slight increase in the number of colony forming bacteria but the growth was found to be below the standards and was negligible.

### Glycemic Index

Table V Glycemic Index Of The Fibre Enriched Rusk

Variations	Glycemic index
Standard	94.3
B1	86.8
C1	86.2
F1	88.9

B1- 10 % Broad beans powder incorporated rusk

C1- 10% Cluster beans powder incorporated rusk

F1- 10% French beans powder incorporated rusk

The glycemic index of the standard rusk was found to be higher than the 10 percent vegetable powders incorporated rusk. The glycemic index of standard was 94.3. The glycemic index of 10 percent broad beans, cluster beans and percent French beans powder incorporated rusk was found to be 86.8, 86.2 and 88.9 respectively.

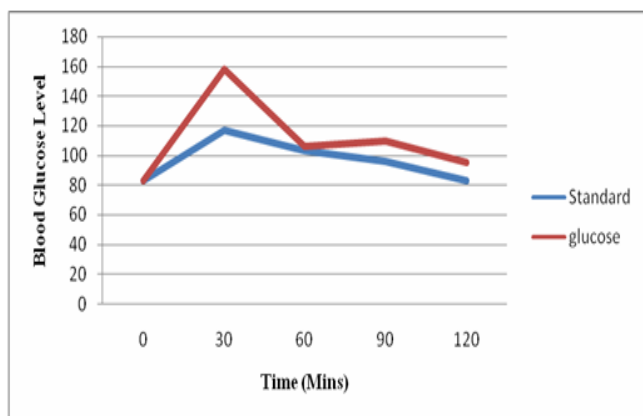


Figure 1. Mean blood glucose response for standard rusk compared with glucose

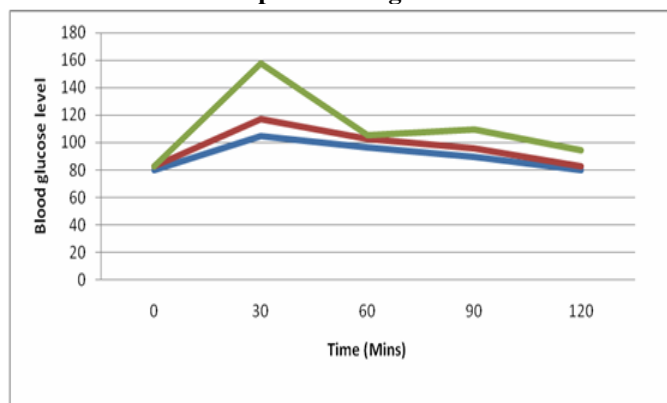


Figure 2. Mean Blood Glucose Response For 10 Percent Broad Beans Powder Incorporated Rusk Compared With Standard Rusk And Glucose

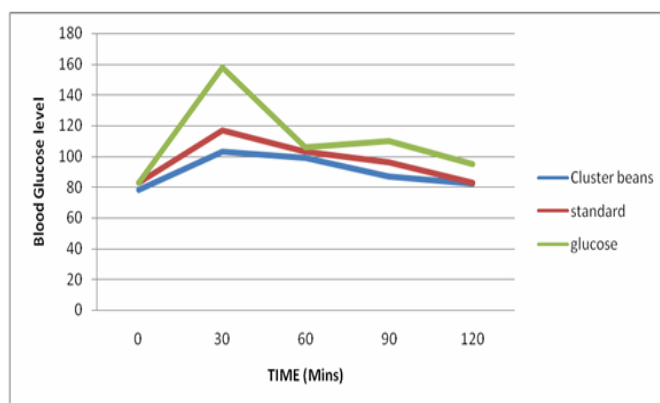


Figure 3. Mean Blood Glucose Response For 10 Percent Cluster Beans Powder Incorporated Rusk Compared With Standard Rusk And Glucose

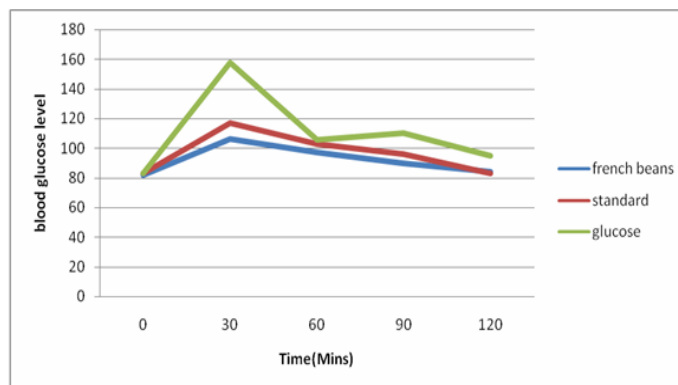


Figure 4. Mean Blood Glucose Response For 10 Percent French Beans Powder Incorporated Rusk Compared With Standard Rusk And Glucose

### Conclusion

From the research it could be concluded that 10 percent level of incorporation of the different vegetable powders were found to be acceptable and the analysis of the crude and dietary fibre content of the rusk increased when compared with the standard. The glycemic index of the standard rusk was 94.3, while the glycemic index of 10% broad beans, cluster beans and French beans powder incorporated rusk was found to be 86.8, 86.2 and 88.9 respectively. Hence it can be inferred that vegetables can be used as a source of dietary fibre for incorporation into bakery products. Bakery products are consumed by a wide range of population and can serve as a vehicle for the incorporation of various functional foods.

### References

- Anderson JW, Baird P, Davis RH Jr, Ferreri S, Knudtson M, Koravm A, Waters V, Williams CL. Health benefits of dietary fiber. *Nutr Rev.* 2009;67:188-205.
- Kamaljit, S. Baljeet and K. Amarjeet, 2010. Preparation of Bakery Products by Incorporating Pea Flour as a Functional Ingredient. *American Journal of Food Technology*, 5: 130-135.
- WHO Fruit and Vegetable Promotion Initiative – report of the meeting, Geneva, 25–27 August 2003.
- Flammang A. M., Kendall D. M., Baumgartner J. C., Slagle T. D., Choe Y. S. (2006). Effect of a viscous fiber bar on postprandial glycemia in subjects with type 2 diabetes. *Am. J. Clin. Nutr.* 25: 409-414.
- Heymann, H., 2010, Sensory Evaluation of food principles and practices, 2<sup>nd</sup> edition, Springer publication, pg:2.
- Flammang A. M., Kendall D. M., Baumgartner J. C., Slagle T. D., Choe Y. S. (2006). Effect of a viscous fiber bar on postprandial glycemia in subjects with type 2 diabetes. *Am. J. Clin. Nutr.* 25: 409-414.

7. Sudha, M.L., Vetrmani, R. and Leelavathi, K. 2007. Influence of fibre from different cereals on the rheological characteristics of wheat flour dough and on biscuit quality. *Food Chemistry* 100: 1365-1370.
8. Da-wen sun, 2012, Handbook of frozen food processing and packaging, 2<sup>nd</sup> edition, Taylor and Francis group, pg: 503.
9. Manay and Shadaksharaswamy, 2007, Food facts and principles, New age India limited, 2<sup>nd</sup> edition, Pp322-335.
10. Jonathan W. DeVries, AOAC International Validated Methods for Nutrient Analysis — Method Availability and Method Needs, 2006.