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Fortification of Cupcakes with Cereals and Pulses

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Abstract: **Supplementation of foods is of current interest because of increasing nutritional awareness among consumers. Supplementation with legumes, cereals and pulses is one way to meet the needs for protein particularly baked foods. Cupcakes can be easily fortified with protein rich flours to provide convenient foods, in order to supplement protein in the diet and nutrition. The present verification was undertaken to explore the possibilities of using corn flour, powdered green gram, powdered oats, powdered peanuts and powdered soybeans in cupcakes without impairing their acceptability. Supplementation of cupcakes with the above mentioned nutritional powders was tried at 25, 50, 75 and 100% along with constant levels of water, fat and baking powder to compare the nutritional and textural quality. From the experiment, it was observed that corn and oat cakes were the tastiest while peanut and soybean cakes used to a 100% proved to be the healthiest.**

Keywords: **cup-cakes, fortification, green gram, oats, peanuts, soybeans.**

1. INTRODUCTION

The cupcake evolved in the United States in the 19th century, and it was revolutionary because of the amount of time it saved in the kitchen. They're portion-controlled, portable, easy to make in batches, open to lots of decorating strategies, tasty and can be inexpensive to make. The use of white flour derived from the processing of whole wheat grain, which is aimed at improving the aesthetic value of white bread, has also led to the drastic reduction in the nutritional density and fibre content when compared to bread made from whole grain cereals. Recently, consumers' awareness of the need to eat high quality and healthy foods – known as functional foods, that is, foods which contain ingredients that provide additional health benefits beyond the basic nutritional requirements, is. Therefore, the trend is to produce specialty bakery products made from whole grain flour and other functional ingredients known as health foods or functional foods. Jideani and Onwubali (2009) [1 reported that the development and consumption of such functional foods not only improves the nutritional status of the general population but also helps those suffering from degenerative diseases associated with today's changing life styles and environment.

The enrichment of cupcakes and other cereal based confections with legume flours particularly in regions where protein utilization is inadequate has long been recognized. Legumes can therefore complement cereals when blended at optimum. Soybean is one of the most important oil and protein crops of the world. Soybeans contain 30 to 45% protein with a good source of all indispensable amino acids (Serrem et al. 2011). The protein content of soybean is about 2 times of other pulses, 4 times of wheat, 6 times of rice grain, 4 times of egg and 12 times of milk. Soybean has 3% lecithin, which is helpful for brain development. It is also rich in calcium, phosphorous, isoflavones and Vitamins A, B, C and D, and it has been referred to as "the protein hope of the future" (Islam et al. 2007). Moreover, isoflavones contained in soybeans are effective cancer-preventive agents for lowering risks of various cancers (El Gharras 2009). A lot of work has been carried out to study the effect of soybean flour in enhancing nutritional quality of biscuits and cookies (Singh et al. 2000; Dhingra and Jood 2004). Protein energy malnutrition is a major health problem in developing countries (FAO 2007).

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The need for strategic development and use of inexpensive local resources in the production of popular foods such as cupcakes has been promoted by organizations such as the Food and Agricultural Organization (FAO), the International Institute for Tropical Agriculture (IITA), and the Federal Institute for Industrial Research, Oshodi (FIIRO), Nigeria. This led to the initiation of the composite flour program, the objective of which was to seek ways of substituting flours, starches and protein concentrates from indigenous crops, for as much wheat as possible in baked products. With increased awareness of a healthy lifestyle based on consumption of functional foods, cupcakes containing whole grain, multi-grain or other functional ingredients especially from legumes will increasingly become more important in the bakery industry and in the emerging market (Dewettinck 2008). Just like soy, various other highly nutritive values can be found green gram, corn, peanuts, and oats (Whitely, 1970; Tharanathan and Mahadevamma 2003). Shakhuntala Masur et al. (2009) in their work carried out the supplementation of wheat biscuits with bengal gram flour which improved dough consistency, over all acceptability, and sensory attributes. Thus the supplementation of bengal gram flour at 15 to 20% level, not only improved protein quality but also improved the dough texture and sensory parameters in the final product. The current study was carried out to study the nutrition parameters of cupcakes made from wheat flour fortified with powdered corn, powdered green gram, powdered oats, powdered peanuts and powdered soybeans. The use of rice bran in biscuits to enhance the nutritional quality has also been investigated (Neha Mishra and Ramesh Chandra, 2012).

2. MATERIALS AND METHODS

Preparation of cupcakes:

The control cupcake (16 Nos) was prepared (1 ½ cup flour, ¾ cup sugar, 2 teaspoon baking powder, ½ teaspoon salt, ½ cup milk, ½ cup oil, 2 eggs, 1 teaspoon vanilla essence). The wet ingredients were added to the dry ingredients and beaten well until smooth and creamy. The mixture was then placed in paper cups and baked for 15 minutes at 180° C. The same procedure was repeated for the test cupcakes with varying flour ratio of powdered corn, powdered green gram, powdered oats, powdered soy and powdered peanuts in terms of 25%, 50%, 75% and 100%.

Moisture Determination:

Moisture was determined by LOD (Loss on Drying) method wherein the samples were initially weighed followed by placing them in the oven for one hour to obtain the final weight. The amount of moisture was calculated using the formula, Moisture content = initial weight- weight after drying.

Determination of total protein:

Five gram of the ground sample was taken with 50 ml of 1N NaOH and boiled for 30 minutes. The solution was cooled in room temperature and centrifuged at 1000× g using a table top centrifuge. The supernatant was collected and total protein content was measured according to the Biuret method (Burtis and Ashwood 2006).

Determination of total lipid:

Total lipid was determined by a slightly modified method of Folch et al. (1957). Five gram of the ground sample was suspended in 50 ml of chloroform: methanol (2:1 v/v). The mixture was then mixed thoroughly and let to stand for 3 days. The solution was filtered and centrifuged at 1000× g using a table centrifuge. The upper layer of methanol was removed by pipette and chloroform was evaporated by heating. The remaining was the crude lipid.

Determination of crude fibre:

Moisture and fat free sample was treated with 0.255N H_2SO_4 and 0.313N NaOH and then washed with ethanol and ether. It was then transferred to a crucible, dried overnight at 80-100° C and weighed (W1) in an electric balance. The crucible was heated in a muffle furnace at 600° C for 6 hours, cooled and weighed again (W2). The difference in the weights (W1-W2) represents the weight of crude fibre (Raghuramalu et al. 2003). Crude fibre (g/100g) = [100-(moisture + fat)] × (W1-W2)/Weight of sample.

Determination of total ash:

One gram of the sample was weighed accurately into a crucible. The crucible was placed on a clay pipe triangle and heated first over a low flame till all the material was completely charred, followed by heating in a muffle furnace for

about 6 hours at 6000 C. It was then cooled in a dessicator and weighed. Then total ash was calculated as following equation (Raghuramalu et al. 2003): Ash content (g/100g) = Weight of ash × 100/Weight of sample taken.

Determination of total carbohydrate:

The content of the available carbohydrate was determined by the following equation (Raghuramalu et al. 2003): Carbohydrate (g/100g sample) = 100 – (Moisture + Fat + Protein + Ash + Crude Fibre).

Determination of metabolizable energy content:

Fat, protein or carbohydrates can supply energy. Metabolizable energy is calculated using the following formula: ME (Kcal /100g) = [(3.5 X CP) + (8.5 X CF) + (3.5 X NFE)] Where, ME = Metabolic Energy; CP = % Crude Protein; CF = % Crude Fat; NFE = % Nitrogen Free Extract (carbohydrate).

3. RESULT AND DISCUSSION

The cupcakes were graded based on their taste, texture and colour and were marked on a scale of 5. The results are tabulated in Table 1. The cupcakes fortified with either oat or corn was tastier than the other cakes, though the texture and colour of cakes fortified with corn was not so satisfactory. All the physical parameters seemed to be unsatisfactory for the cakes made of 100 % soybean powder. However, substitution of 10 % soy flour into wheat flour gave good quality bread (Joel Ndife et al. 2011).

Table 1: Physical parameters of cupcakes

Cupcake Flour ratio	Taste (scale of 5)	Texture	Colour
control	4	Soft, moist and smooth	Golden brown
25% oat	4.5	Soft, moist and smooth	Golden brown
50% oat	4.5	Soft, moist and smooth	Golden brown
75% oat	4.25	Soft, moist and smooth	Golden brown
100% oat	4	Soft, moist and smooth	Golden brown
25% corn	4.2	Gritty	Yellowish golden brown
50% corn	4	Gritty	Yellowish golden brown
75% corn	4	Gritty and hard	Yellowish golden brown
100% corn	4	Gritty and hard	Golden yellow
25% green gram	3.5	Partly grainy	Greenish brown
50% green gram	3.25	Partly grainy	Greenish brown
75% green gram	3	Partly grainy and gritty	Greenish brown
100% green gram	2.75	Partly grainy and gritty	Green
25% peanut	3.5	Flat and slightly oily	Light brown
50% peanut	3.30	Flat and oily	Brown
75% peanut	3.20	Flat and sticky	Brown
100% peanut	3	Flat and sticky	Brown
25% soya	3.75	Bread like	Creamish beige
50% soya	3.5	Bead like	Creamish beige
75% soya	3	Hard and bread like	Dark beige
100% soya	2.5	Hard an dry	Dark beige

The moisture content was also at the higher end for both oat and corn cakes when compared to others. Soybean fortified cakes seemed to be drier and less tasty (Table 2). The protein content had increased in all the fortified cakes when compared to the control (Table 3). The lipid content was more in cakes fortifies with peanut and was the least in soybean and green gram fortified cakes. While the fibre content was slightly higher, the ash content was slightly lower in all the fortified cakes when compared to the control. Soybean flour had a greater capacity to absorb water and oil and at 50 % level gave higher scores for all sensory attributes (Grover and Singh 1994; Akubor and Ukwuru 2005).

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Table 2 Moisture content in cupcakes

S.No	CUPCAKE	MOISTURE CONTENT (%)
1	Control	18.0
2	25% corn	21.0
3	50% corn	19.0
4	75% corn	15.0
5	100% corn	15.0
6	25% green gram	13.6
7	50% green gram	13.6
8	75% green gram	9.8
9	100% green gram	13.2
10	25% oats	17.6
11	50% oats	18.6
12	75% oats	18.6
13	100% oats	21.0
14	25% peanut	11.2
15	50% peanut	9.2
16	75% peanut	9.0
17	100% peanut	9.0
18	25% soy	13.8
19	50% soy	12.8
20	75% soy	12.0
21	100% soy	11.0

The benefits of increased dietary fibre intake have been emphasized and studied extensively (Best 1987; Slavin 2005). It has been found that the incorporation of fibre in food products can alter the consistency, texture and taste of food (Vitali et al. 2009; Devinder Singh et al. 2012). There was no significant change in the carbohydrate content in all the fortified cakes in comparison with the control. However, the metabolizable energy content was higher in all the fortified cakes when compared with the control.

Table 3 Nutritional analysis of cupcakes

	TOTAL PROTEIN (g/100g)	TOTAL LIPID (g/100g)	CRUDE FIBRE (g/100g)	TOTAL ASH (g/100g)	TOTAL CARBOHYDRATE (g/100g)	METABOLIZABLE ENERGY CONTENT (Kcal/100g)
control	8.4	3.7	3.94	2	64.4	286.25
25% corn	10.5	3.48	3.81	3	63.84	289.77
50% corn	11.5	3.27	3.98	1.8	64.8	294.84
75% corn	21	3.13	4.15	1.6	63.84	323.54
100% corn	16.2	2.97	4.21	1.4	63.7	304.89
25% green gram	11.58	3.07	3.58	2	65.11	294.51
50% green gram	15.6	2.95	3.69	1.8	64.26	304.58
75% green gram	16.38	2.82	3.76	1.6	64.4	306.7
100%green gram	17.79	2.74	3.85	2.2	63.46	307.665
25% oats	18.39	3.3	3.80	1.8	63.06	313.125
50% oats	15.96	3.12	3.91	2.2	63.38	304.21
75% oats	9.6	2.96	4.03	1.6	65.46	287.87
100% oats	11.58	2.83	4.18	2	64.65	290.86
25% peanut	24	3.68	3.9	1.6	61.69	331.19
50% peanut	18.9	3.75	4.05	1.4	63.17	319.12
75% peanut	16.2	3.89	4.19	1.6	63.66	312.57
100% peanut	30.39	4.02	4.37	1.6	64.23	365.34
25% soy	16.2	2.97	3.67	1.6	64.02	306.01
50% soy	11.1	2.85	3.90	3	64.43	288.58
75% soy	10.5	2.72	4.13	1.8	65.08	287.65
100% soy	20.4	2.7	4.24	1.8	65.36	323.11

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4. CONCLUSION

The experiment was carried out in order to find suitable substitutes for Maida in the production of cupcakes. Five different types of powdered substitutes, primarily, corn, oats, green gram, peanut and soybean. From the above experiment, it was noted that peanut and soybean used to a 100% is the most nutritive. The taste and texture is maintained in the cupcakes made with oats and corn.

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