DEVELOPMENT OF CALCIUM RICH VEGAN CHOCOLATE TEA CAKE FOR ADOLESCENTS

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ABSTRACT

Background: *The world comprises of 1.2 billion of Adolescents. India has the largest population of adolescents in the world being home to 243 million individuals aged between 10-19 years that hold the future powerhouse of the country. During this phase adolescents go through a lot of changes. Peer Pressure is very high during adolescence; following the trend makes them eat non-nutritious junk food which leads to lifestyle disorders. A finger food like Tea cake will be a fancy option for adolescents as a snack which will take care of calcium need, as this nutrient is essential for adolescent period.* **Objective:** *The purpose of the study was to develop a Calcium rich Vegan chocolate tea cake for Adolescents and perform Sensory evaluation for the developed product.* **Methodology:** *The recipe developed was Vegan, with chocolate flavor from unsweetened cocoa powder, as it's the most popular flavor among adolescents and has array of health benefits. Five variations of Chocolate Tea Cakes were developed having different proportion of Refined Flour, Ragi Flour and Whole Wheat Flour into it. Sensory evaluation was done by 40 semi-trained adolescents.* **Results:** *The findings showed that the Tea Cake developed by combination of Ragi and Whole Wheat Flour was more acceptable than the one developed by only Refined Flour. The sample with Ragi and Whole Wheat flour was not just tasty but met other sensory parameters too, only the colour of the cake was a few shade darker than the other samples.* **Conclusion:** *The study revealed that popular snacks can easily be converted into healthy substitutes. The sample Tea cake which was substituted with 100% Ragi and Whole Wheat Flour mixture was the most acceptable sample of all.*

Key Words: *Adolescents, Cake, Calcium, Vegan, Sensory Evaluation.*

INTRODUCTION

According to Census report 2011 today in India every fifth person is an adolescent, which accounts to around 236.5 million. World Health Organization (WHO) defines 'adolescence' as an age spanning from 10 years to 19 years (Singh and Krishna, 2014). Adolescence is marked by rapid development and changes in the body. It is the period between childhood and adulthood. Eating pattern comes into lime light during this stage. Due to their busy schedules, peer pressure, independent nature and

self-identity searching, adolescents may sometimes skip meals, eat only snacks, try unconventional meals or consume excessive amounts of fast food, soft drinks and alcohol and diet to the extreme. There is a greater demand for calories and nutrients due to dramatic increase in physical growth and development over a short period of time. According to ICMR (2010) energy requirement of Indian Boys of Sedentary work type of age 16-17 years with body weight of 55.4 is 3020 kcal/day, while Girls of Sedentary work type of age between 16-17 years with body weight of 52.1 is 2240 kcal/day.

Calcium is an element that is a fundamental part of the body and its importance is related to the functions it performs in bone mineralization, primarily related to bone health, which include formation and maintenance of the structure and rigidity of the skeleton. (Cobayashi, 2004). The nutritional recommendations for calcium vary throughout people's lives, with higher requirements during periods of rapid growth, such as during childhood and adolescence, during pregnancy and lactation, in cases of calcium deficiency, when practicing forms of exercise that result in high bone density and increased calcium absorption and in old age (Flynn, 2003). The ideal calcium intake is that which results in adequate peak bone mass when a child and an adolescent, that maintains it during adulthood and minimizes losses when elderly (Grüdtner, et al,1997). Recommended Dietary Allowance (RDA) for calcium for an adolescents is 800 mg/day (Gopalan and Shastri, 2010).

Calcium is a very important macronutrient during the stage of adolescents. The hormonal changes associated with the pubertal period promote greater mineral utilization, which needs to be satisfied with suitable calcium consumption. Adequate intake of calcium throughout childhood and adolescence is important for proper mineralization of growing bones, attainment of peak bone mass, and reduction of risk of bone fracture and osteoporosis in adulthood (The National Academies Press; 2011). Until recently, it was believed that a low calcium intake did not result in damage to health. Nowadays, it is thought that global variations in prevalence rates of calcium deficiency may affect the bone distribution and dietary habits of different populations, in response to genetic, ethnic and geographic (latitude) differences and related to cultural and lifestyle factors (Joint FAO/WHO Expert Consultation on Human vitamin and mineral requirements, 1998).

Snacks form an important part of daily food intake and energy requirements, adolescents have a tendency to skip meals and nibbling later, thus a healthy alternative, to a popular snack, is best option for adolescents to meet energy requirements and also to replenish lost nutrients. Dietary habits and food preferences which affect energy consumption and nutrient intake are generally developed over a period of time and particularly during adolescence. Two major factors affect food choices during adolescence. The first is a greater quest for independence; as in earlier periods of life, one of the ways independence is exhibited is through eating, or not eating. It is often a time for making rebellious or non-conformist statements and adopting social causes. This, coupled with a lack of knowledge and experience necessary to make adequate evaluations of dietary practice, may lead to the adoption of ill-

conceived diets. The second factor is greater purchasing power to obtain meals, snacks and beverages. Rather than relying solely on family foods, sources of food may include food outlets, vending machines and school canteens.

Cake is the form of food that is usually sweet and often baked. It supplies body building protein, fats and carbohydrates. Cakes are very common form of snacks that quench sudden hunger calls and gives satiety. Cakes are easily popular and acceptable snacks preferred by adolescents, also can be consumed anywhere as a finger food, thus if this snack can be produced with a much richer nutritive content it would serve both purpose of hunger and healthy snacking.

A basic cake is made of White/Refined flour. White flour is wheat flour that has been stripped of two main components–the bran and the germ (Satya et al, 2011). The bran provides the fiber that is typically found in the whole grain, but when it is taken out of the wheat flour it creates a softer, lighter texture. This is why, if you've ever replaced white flour for whole-wheat flour, the final product is often heavier and denser. That's the fiber and the added weight of the other components missing from white flour. The trouble is, the light and airy texture of the bread is fairly descriptive of its nutritional quality as well–light, airy, and vapid. The production of white flour involves stripping away of the most nutritional aspects of the grain: the germ and the bran. It also includes the addition of lost B vitamins and iron, and bleaching it with a chemical bleaching agent to make it appear bright white. The flour itself is devoid of the fiber which aids in passing easily through the large intestine. A person following a diet that regularly includes eating white flour as well as sugar (fructose, primarily), or products made with the ingredients, increases their chances for weight gain, insulin resistance, and type 2 diabetes (Amin and Gilani, 2013)

Ragi provides 344 mg of calcium per 100 gms of edible portion (Gopalan and Sastri, 2009). Ragi provides highest level of calcium, antioxidants properties, phytochemicals, which makes it easily and slowly digestible. Hence it helps to control blood glucose levels in diabetic patients very efficiently. Ragi has best quality protein along with the presence of essential amino acids, along with good amount of vitamin A, vitamin B and phosphorus (Gopalan et al, 2004) The bulkiness of the fibres and the slower digestion rate makes us feel fuller on, fewer calories and therefore may help to prevent us from eating excess calories. Therefore, Ragi is considered to be ideal food for diabetic individuals and other metabolic disorders due to its low sugar content and slow release of glucose/sugar in the body (Kang et al, 2008 and Lakshmi and Sumathi, 2002). Hence in the following study Refined flour is substituted with Ragi flour that serves both purpose of meeting daily Calcium intake and quenching hunger calls.

Vitamin A deficiency in children and adolescents is a major public health problem worldwide, especially in less developed countries (Underwood BA, Arthur P, 1996 & UN Standing Committee on Nutrition, 2004). Thus the cake uses carrot puree that takes care of the Vit. A requirements. In the following study carrots also helps in enhancing the flavor of the Tea Cake.

Using chocolate as a flavor has added benefits like it lowers LDL cholesterol, prevents heart diseases by increasing blood flow, provides antioxidants and reliefs stress. Girls especially during adolescent period experience mood swings, sudden cravings due to hormonal changes chocolate keeps that in check as well.

Vegan diets are growing in popularity today among teenagers and youth, especially females. For many vegans, nutritional choices center around taking better care of the earth's resources and the environment, ethical issues about animal care, the use of antibiotics and growth stimulants for the production of animals, the threat of animal-borne diseases, and the health advantages of a plant-based diet (Jacobsen, 2006, and Fox et al, Health 2008). Vegan diets are usually higher in dietary fiber, magnesium, folic acid, vitamins C and E, iron, and phytochemicals, and they tend to be lower in calories, saturated fat and cholesterol, long-chain n–3 (omega-3) fatty acids, vitamin D, calcium, zinc, and vitamin B 12 (Davey et al, 2003). In general, vegetarians typically enjoy a lower risk of cardiovascular disease (CVD), obesity, type 2 diabetes, and some cancers (JADA, 2003). A vegan diet appears to be useful for increasing the intake of protective nutrients and phytochemicals and for minimizing the intake of dietary factors implicated in several chronic diseases (Dewell et al, 2008).A vegetarian diet provides a variety of cancer-protective dietary factors (Liu, 2004). A higher consumption of fruit and vegetables, which are rich in fiber, folic acid, antioxidants, and phytochemicals, is associated with lower blood cholesterol concentrations (Djoussé , et al, 2004), a lower incidence of stroke, and a lower risk of mortality from stroke and ischemic heart disease (Bazzano, et al, 2002). Being or following vegan diets has its benefits too as it helps to reduce weight successfully, most animal products are harmful to health in long run, saves animals from slaughtering and also it's in trend which is promoted by lot of celebrities (www.peta.org). Vegans are thinner, have lower serum cholesterol and blood pressure, and enjoy a lower risk of CVD. BMD and the risk of bone fracture may be a concern when there is an inadequate intake of calcium and vitamin D. Where available, calcium- and vitamin D –fortified foods should be regularly consumed (Craig, 2009). Thus in the present study Calcium was added to the Tea cake to combat the calcium loss in adolescents. Vegan choice of ingredients in cake making has increased the acceptability of the cake, as there are many people who do not consume animal products due to religious reasons or allergy reactions. The objective of the present study was to develop a Calcium rich Vegan chocolate tea cake for Adolescents and perform Sensory evaluation for the developed product. This study aimed at developing a healthy substitute for the same by replacing plain refined flour with a mixture of Ragi and Whole Wheat Flour.

METHODOLOGY

The present study tried to develop Calcium rich version of a basic Refined Flour Cake that has been substituted with various proportion of a mixture of Ragi and Whole Wheat Flour, the study also assessed the acceptability of the same by adolescents. They study was partially conducted at Bakery Laboratory,

Craftsmanship Course Food Production Laboratory of Institute of Hotel Management, Pusa, New Delhi and surrounding areas of Rajender Nagar & East Patel Nagar, New Delhi. The sensory evaluation of Vegan Chocolate Tea Cake samples was carried out by a panel of 40 adolescents ranging between the age of 10 to 18 years. The cake was prepared by adding the various quantities of Flour, Ragi and Whole Wheat mixtures to a liquid mixture that was common for all. The formulations of cakes prepared from different proportions of Wheat, Refined Flour and Ragi Flour are given in Table 1. The ingredients used in this recipe are provided in Table 2. The procedure is explained in Flow Diagram 1. Each samples of cake were of 30 gm that were provided for Sensory evaluation. The subjects were first gathered together then handed a copy of 'Cake Evaluation Form' to fill in their personal details containing information regarding their Name, Age, Gender and Date of Birth. For better understanding a Hedonic scale ranging from 1 to 5 was provided in the evaluation form where 1 denoted 'Dislike Extremely', 2 denoted 'Dislike Moderately', 3 denoted 'Neither Like or Dislike',4 denoted 'Like Moderately' and 5 denoted 'Like Extremely. Then each of them were separately provided with a glass of water and five samples of the tea cake which were labeled A, B, C, D and E respectively. They were informed to first wash their mouth then look, smell and taste the cakes and mark them accordingly out of 5 against the various attributes of the cake and this process would be repeated five times for the five samples. After tasting the samples and evaluating them on the form it was submitted to the authors.

Table 1: Different Variation of Flour content

Sample codes	Refined Flour (%)	Wheat Flour (%)	Ragi Flour (%)
A	100	0	0
B	75	12.5	12.5
C	50	25	25
D	25	37.5	37.5
E	0	50	50

Table 2: List of Ingredients

S.No.	Ingredients
1.	Hydrogenated vegetable oil
2.	Brown/cane sugar
3.	Cocoa powder
4.	Baking powder
5.	Baking soda
6.	Salt
7.	Coconut milk

8.	Apple Cider Vinegar
9.	Brewed coffee
10.	Vanilla essence
11.	Carrot

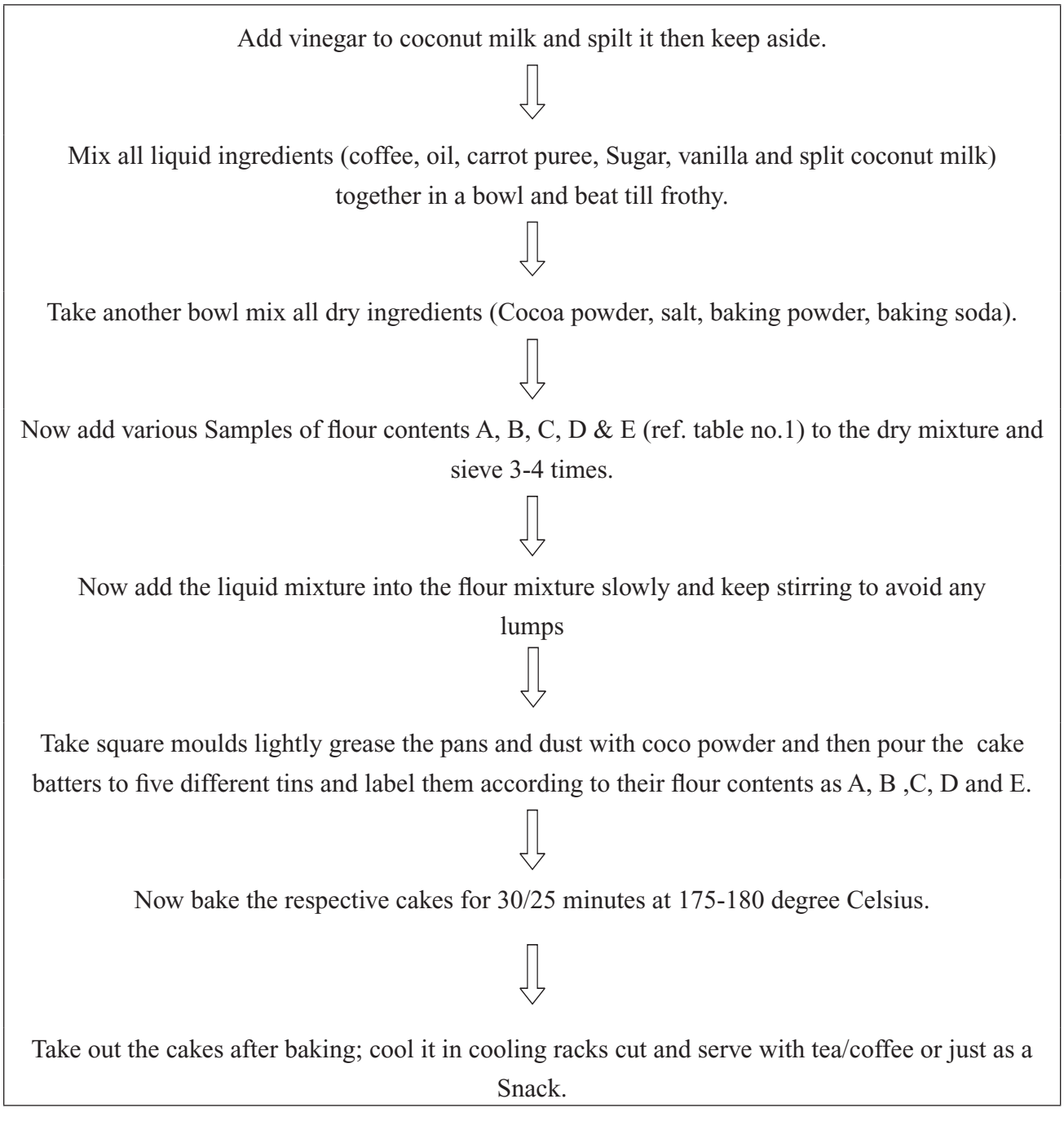

Figure 1: Schematic diagram for the developed product

RESULTS AND DISCUSSION

All the Cake combinations were analyzed for their acceptability by the evaluation panel in the form of Tea cake. Namely Basic Cake Flour supplemented with a mixture of Ragi Flour and Whole Wheat Flour in, difference of (12.5%) in each flour proportion respectively of each sample. (Table 1)

Tea Cake: The Tea cakes made out of the Ragi and Whole Wheat combinations were scored for sensory evaluation by the panel member for their Aroma, Flavour, Colour, Taste, Appearance and Overall Acceptability. A 'Cake Evaluation Form' was designed with all the sensory parameters. The mean for the scores given in the 'Cake Evaluation Form' by the panel members was calculated and compared across all five products. The mean of these scores has been presented in Table No 3.

Table 3: Means of the samples according to their various parameters:

Sample	Aroma	Flavour	Colour	Taste	Appearance	Overall acceptability
A	3.2 ±0.71	3.45±0.63	3.5±0.86	3.35±0.82	3.3±0.71	3.42±0.66
B	3.27±0.77	3.05±0.94	3.55±0.77	3.3±0.9	3.32±0.75	3.4±0.8
C	3.22±0.90	2.82±1.09	3.37±0.76	3.02±1.10	3.1±0.88	3.07±0.95
D	3.25±0.91	3.17±0.97	3.22±0.65	3.32±0.98	3.15±0.85	3.45±0.83
E	3.32±1.0	3.77±0.90	3.52±0.67	3.67±0.98	3.35±0.93	3.75±0.8

Aroma:

The mean for the aroma scores given in the Cake Evaluation Form by the panel members was calculated and compared across all five products. The mean of these scores of product E and B got highest score and thus were the most acceptable for aroma of Tea Cake followed by product D and C respectively. Product A was least acceptable among the entire samples produced, as it was overpowered by dominant aroma of Cocoa Powder (Table 3).

Flavour:

The mean for scores given by the panel for Flavor was compared and noted, E came out as the most favorable followed by A, D and B. The sample C came out as the least acceptable sample of all may be due to the proportion of usage of all the flours (Table 3).

Colour:

The mean for colour by the panel was compared and seen that B was the most acceptable sample followed by E, A and C. As shown D was the least acceptable in terms of colour as it had dark crust formation due to prolonged baking (Table 3).

Taste:

The mean for the scores given in the sensory evaluation from the panel member was calculated and compared across all five products for Taste. After calculations of mean of these scores, product E got the highest score and thus was the most acceptable due to its rich taste produced by higher concentration of Ragi and Whole wheat flour followed by sample A, D and B. Sample C was the least acceptable one, as it was the third sample and the strong proportions of various flours was easily identified but was not accepted (Table 3).

Appearance:

Product E got the highest scores on appearance basis followed by B and thus was most acceptable in Tea cake samples further followed by product A and D respectively. Product C was least acceptable among the entire group of samples due to prolonged baking it was ill structured with cracks on top (Table 3).

Overall Acceptability:

When it comes to overall acceptability of the Tea cake samples then it's found that product E was most acceptable of all followed by D, A and B. It's found that C is the least acceptable of all as it was ill structured due to prolonged baking, being the third sample its proportions of flours were not accepted due to high variations (Table 3).

Overall comparison of the samples:

The scores obtained by Calculating the Mean of the parameters - Aroma, Flavour, Colour, Taste, Appearance and Overall Acceptability were assessed. After regressing these were compared across the five Tea Cake Samples. Overall comparing of Tea cake samples has been shown in Table 10. It was found that product E was the most preferred Tea cake in almost all aspects as it was perfectly moist, chocolate flavor was complementing the high proportioned Ragi Flour's robust aroma and earthy taste (Table 4).

Table 4: Overall comparison mean of the samples

Parameters	SAMPLES	
	Most Acceptable	Least Acceptable
Aroma	E	A
Flavour	E	C
Colour	B	D
Taste	E	C
Appearance	E	C
Overall Acceptability	E	C

Table 5: Nutritive Value of Most accepted Sample (E)

Nutrient Content	Per 100g	Per 150g
Energy (Kcal)	340.69	511.4
Fat (g)	21.6	32.4
Protein (g)	3.17	4.76
Carbohydrates (g)	30.29	45.44
Fiber (g)	2.70	4.06
Calcium (mg/d)	79	118.5

*1 Portion = 150g
Nutritive Value Calculated by (NIN), ICMR, 2000
Total calcium requirement per meal for adolescents is = 800 / 6 (No. of meals /day) = 133 mg/meal
One (1) portion of cake alone is providing 89% of calcium requirement/meal i.e. 118.5 mg Calcium.

CONCLUSION

In the recent years the consumption and production of healthy snacking has increased by several folds, no longer is the trend of selling hollow calorie foodstuffs. Scientists and Food nutritionists are constantly developing foods that serve hunger as well as promote healthy living. Mostly all foodstuffs today are fortified or the recipes are changed to healthy versions to provide nutritive rich substitutes for healthy lifestyle. Ragi is a food crop that is produced in various states of India in major quantities. Ragi, is also known as Finger Millet, African Millet or Nachani. Ragi is a good source of minerals such as Calcium, Iron, Niacin, Thiamin and Riboflavin. In fact, Ragi is a great source of calcium compared to brown rice, corn and wheat. After the sensory evaluation it's clear that the sample E with 100% usage of Ragi and Whole wheat flour proves to be the preferred choice for adolescents as it was both tasty and healthy. The colour of the sample E that had the highest Ragi and Whole Wheat concentration was few shades darker than the other samples. The recipe is very simple and hassle free which consumes very little time so can easily be made by anyone who wants their growing children to snack healthy, the calculated nutritional value chart evidently projects the same, total calcium requirement per meal for adolescents is 800 mg /day. One (1) portion of cake alone is providing 89% of calcium requirement/ meal i.e. 118.5 mg Calcium. Thus it's evident that adolescents are open to healthy substitutes, a little bit more research in this field could easily take care of hunger and promote blissful living.

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