ORIGINAL ARTICLE

Development of nutritious snacks by incorporation of amaranth seeds, watermelon seeds and their flour

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Abstract

The present study was carried out with the objectives to find out the sensory acceptability, the nutrient content and cost of prepared products. The products prepared were “Biscuits”, “Mathri” and “Laddoo” by incorporation of amaranth seeds, watermelon seeds and their flour in different proportions (10:10, 20:10, and 30:10) served as treatments T1, T2 and T3 respectively T0, without incorporation of amaranth seeds, watermelon seeds and their flour served as control. The products were organoleptically evaluated by using Nine point Hedonic scale. The data obtained during study were analyzed statistically using analysis of variance and C.D techniques. The prepared products were analyzed for nutrient content using the standard method of AOAC (2005).It was concluded that in case of “Biscuits” and “Mathri” with incorporation level 20 percent amaranth seeds flour and 10 percent watermelon seeds flour scored highest while in case of “Laddoo” with incorporation level 20 percent amaranth seeds and 10 percent watermelon seeds scored highest, with regard to colour and appearance, body and texture, taste and flavour and over all acceptability, However all the treatments were found to be acceptable. It is therefore concluded that amaranth seeds and watermelon seeds can be suitably incorporated in various developed products. “Laddoo” had maximum carbohydrate (64.49g/100g), protein (13.59g/100g) calcium (100.1mg/100g) and iron (3.33mg/100g) content. The content of Protein (14.46g/100g), carbohydrate (59.90) Calcium (59.90mg/100g), were increased as compared to control in “Biscuits”. “Mathri” was rich in Protein, Fat, carbohydrate and calcium content (11.10g/100g, 38.56g/100g, 38.83g/100g, and 53.95mg/100g). Cost of products on the basis raw ingredients per 100g ranged between Rs 6.33-12.45 for “Biscuits”, Rs 16.06-30.07, Rs 12.27-18.19 for “Mathri” and Rs.6.42-12.26 for “Laddoo”. On the basis of findings it is concluded that amaranth seeds, watermelon seeds and their flour can be incorporated in the preparation of different products as well as improve their nutritional composition.

Key Words

Nutrition; Organoleptically

Introduction

The prevalence of underweight children in India is among the highest in the world, and is nearly double that of Sub-Saharan Africa with dire consequences for mobility, mortality, productivity and economic growth. Almost all the hungry people, 852 million, live in developing countries, representing 15 percent of the population of developing countries. There are 16 million people undernourished in developed countries. In India 44% of children under the age of 5 are underweight. 72% of infants and 52% of married women have anaemia. Amaranth is good source of protein, soluble fibre, calcium, iron, magnesium, zinc, vitamin A, C and several B vitamins. It contains about four times as much calcium as wheat and twice as much iron and magnesium. Flavonoids (such as rutin and some phenolic acids as gallic acid, p-Hydroxybenzoic acid and vanillic acid)

with anti-oxidant effects also occur in amaranth seedssand sprouts. Amaranth is gluten-free and easy to digest. The health benefits attributed to amaranth include decreasing plasma cholesterol levels protecting the heart, stimulating the immune system, exerting an anti-cancer activity, reducing blood glucose levels and improving conditions of hypertension and anaemia. In addition, it has been reported to possess anti-allergic and anti-oxidant properties. The most common use of amaranth grain is grinding it into flour, or popped in a similar way to popcorn or used as flakes. The flour is commonly used in cereals, pastas, pancakes, crackers, breads, cookies and other baked goods, and can be combined with other types of flours. Nutritive value of Amaranth seeds (100g) consists of Energy 319kcal, Protein 14.7g, Fat 1.9 g, Carbohydrate 60.7g, Calcium 510mg, Phosphorus 397mg, Iron 11.0mg,Minerals 3.1g,Moisture 10.0g,Crude Fibre 9.6g, (Gopalan et al.2007). Watermelon seeds are very high in protein; it consists of nine essential amino acids, including tryptophan, glutamic acid, and lysine. The seeds are low in carbohydrate but high in calories, so roasted watermelon seeds can be a good choice for supporting athletes activities. Watermelon seeds are also loaded with several of the B vitamins like thiamin, riboflavin, niacin, vitamin B6 and pantothenic acid, which are necessary for converting food into energy and other important bodily functions. The most prevalent B vitamin in watermelon seeds is niacin. Niacin is important for maintaining the nervous system, digestive system and promotes skin health. Magnesium is the most abundant mineral. It helps regulate blood pressure. Other important minerals in watermelon seeds are phosphorous, iron, potassium, sodium, copper, manganese and zinc. Iron is a vital nutrient your body needs for proper oxygen delivery throughout your body and cell growth. It also contains saturated fat, monounsaturated fats, polyunsaturated fats, and omega-6 fatty acids which can help in the reduction of high blood pressure. Polyunsaturated fats may help improve your cholesterol levels and reduce your risk of both heart disease and type 2 diabetes. Watermelon seeds are effective in recovering health after illness and sharpening your memory Nutritive value of Water melon seeds (100g) Energy 628kcal, Protein 34.1g, Fat 52.6 g, Carbohydrate 4.5g, Calcium 100mg, Phosphorus 937mg, Iron 7.4mg,Minerals 3.7g,Moisture 4.3g,Crude Fiber 0.8g, (Gopalan et al.2007).Globally, wheat is the leading source of vegetable protein in human food, having a higher protein content than other major cereals, maize (corn) or rice. The whole grain can be milled to leave just the endosperm for white flour. The by-products of this are bran and germ. The whole grain is a concentrated source of vitamins, minerals, and protein, while the refined grain is mostly starch. Raw wheat can be ground into flour or, using hard durum wheat only, can be ground into semolina; germinated and dried creating malt; crushed or cut into cracked wheat; parboiled (or steamed), dried, crushed and de-branned into bulgur also known as groats. Wheat is a major ingredient in such foods as bread, porridge, crackers, “Biscuits”, Muesli, pancakes, pies, pastries, cakes, cookies, muffins, rolls, doughnuts, gravy, boza (a fermented beverage), and breakfast cereals (e.g., Wheatena, Cream of Wheat, Shredded Wheat, and Wheaties). Nutritive value of wheat flour (100g) Energy 348kcal, Protein 11.0g, Fat 0.9g, Carbohydrate 73.9g, Calcium 23mg, Phosphorus 121mg, Iron 2.7mg, (Gopalan et al.(2007). In a country like India, with increasing development and commercialization people are concentrating more on snack rather than regular meals, reason being they can be easily prepared without taking much time and are equally filling. The present topic is chosen keeping in mind the enhancement of nutritional value of these snacks. In India protein energy malnutrition is the major nutritional problem among children, and women with lower socio economic group have the deficiency of iron, calcium and magnesium. Calcium deficiency is more common in women after menopause. So for reducing malnutrition and minerals deficiency, one method is best that is the use of unconventional seeds and cereal like grains as a source of protein and minerals.

Aims & Objectives

Objectives were to develop and standardize recipes by incorporation of amaranth seeds, watermelon seeds and their flour, to find out the sensory acceptability and to determine the nutrient content and cost of the prepared products.

Material and Methods

The study was conducted in the Nutrition Research Laboratory, Department of Foods and Nutrition, Ethelind School of Home science, Sam Higginbottom Institute of Agriculture, Technology & Sciences, (Deemed to be University), (Formerly Allahabad Agricultural Institute) Allahabad. Wheat, water

melon seeds, amaranth seeds of mix flour and other raw materials was purchased from the local market of Allahabad, U.P. The standard procedure was slightly modified for the preparation of amaranth seeds flour and watermelon seed flour was followed as per the Muyonga et al. (2008) and Ubbor and Akobundu, 2009 respectively. Three food products ("Biscuits", "Mathri"and "Laddoo") were prepared with the incorporation of amaranth seeds, watermelon seeds and their flour.For each product, the basic recipe (control T0) had three variations, T1, T2, T3 respectively, where the amount of one or more ingredients was varied.

Details of treatments

(1) "Biscuits" -:Control (T0): "Biscuits" prepared from wheat flour refined.Treatment (T1): "Biscuits" prepared from mixture of wheat flour refined, amaranth seeds flour and watermelon seeds flour in the ratio of 80:10:10.Treatment (T2): "Biscuits" prepared from mixture of wheat flour refined, amaranth seeds flour and watermelon seeds flour in the ratio of 70:20:10.Treatment (T3): "Biscuits" prepared from mixture of wheat flour refined, amaranth seeds flour and watermelon seeds flour in the ratio of 60:30:10.

(2) "Mathri"-:Control (T0): "Mathri" prepared from wheat flour refined.Treatment (T1): "Mathri" prepared from mixture of wheat flour refined, amaranth seeds flour and watermelon seeds flour in the ratio of 80:10:10.Treatment (T2): "Mathri" prepared from mixture of wheat flour refined, amaranth seeds flour and watermelon seeds flour in the ratio of 70:20:10.Treatment (T3): "Mathri" prepared from mixture of wheat flour refined, amaranth seeds flour and watermelon seeds flour in the ratio of 60:30:10.

(3) "Laddoo"-: Control (T0): "Laddoo" prepared from semolina. Treatment (T1): "Laddoo" prepared from mixture of semolina, amaranth seeds and watermelon seeds in the ratio of 80:10:10. Treatment (T2): "Laddoo" prepared from mixture of, semolina, amaranth seeds and watermelon seeds in the ratio of 70:20:10.Treatment (T3): "Laddoo" prepared from mixture of semolina, amaranth seeds and watermelon seeds in the ratio of 60:30:10.

Control and each of the treatments for each product were replicated three times. Sensory evaluation of the food products for their acceptability was done by a panel of judges. The score card based on the 9 point Hedonic Scale was used for sensory evaluation on the basis of evaluation of attributes like Color and Appearance, Texture, Taste & Flavour and Overall Acceptability. (Srilakshmi, 2007). Proximate analysis-chemical estimation of moisture, ash, protein, fat and carbohydrate content was done by using standard procedures. (AOAC, 2005). Calcium and iron were estimated by AOAC (2005) using standard procedures. The cost of the products was determined on the basis of price of raw ingredients at the prevailing market price.

The data obtained from sensory evaluation were statistically analyzed by using analysis of variance technique (one way classification). Significant difference between the treatments was determined by using CD (critical difference) techniques and t-test was used to analyse the data. (Gupta et. al, 2002)

Results & Discussion

The results obtained from the analysis are presented and discussed under the following sub headings.

A. ORGANOLEPTIC CHARACTERISTICS OF THE PREPARED PRODUCTS

The table 1 shows the mean scores of "Biscuits" in relation to colour which indicates that T2 (wheat flour refined + amaranth seeds flour + watermelon seeds flour 70:20:10) had the highest score followed by T0 (wheat flour refined 100), T1 (wheat flour refined + amaranth seeds flour + watermelon seeds flour 80:10:10) and T3 (wheat flour refined + amaranth seeds flour + watermelon seeds flour 60:30:10) respectively. Scoring shows that the treatment T2 was liked very much while control and T0, T1, and T3 were moderately liked by the panel of judges. The texture of "Biscuits" clearly indicates that the treatment T2 had the highest score for the texture of "Biscuits" T0, T1 and T3 respectively. The mean score of "Biscuits" in relation to taste and flavour was obtained by T0 and T1, T2, T3 respectively indicating that T2 gave the best taste and flavour to, "Biscuits". The mean scores of "Biscuits" in relation to overall acceptability indicate that the treatment T2 scored maximum followed by treatment T0.T1 and T3 respectively. It is seen that addition of 20% amaranth seeds flour and 10% watermelon seeds flour in the treatment T2 improved overall acceptability of "Biscuits".

The ANOVA shows that the calculated value of F (62) was higher than the table value F (4.76) at 5% probability level. This shows that there is significant difference between the control and treatments of colour indicating that the addition of different proportions of amaranth seeds flour and

watermelon seeds flour (10:10, 20:10, 30:10 for T1, T2, T3 respectively) affect the colour of the prepared product. The colour of biscuits becomes lightly darker and more acceptable at the ratio of 20:10 (T2) whereas the product was not acceptable at the ratio of 10:10 and 30:10. This shows that there is significant difference between the control and treatments of taste and flavour indicating that the addition of different proportions of amaranth seeds flour and watermelon seeds flour affect the taste & flavour of the prepared product, the taste &flavour becomes delicious and more acceptable as the amount of amaranth seeds flour and watermelon seeds flour increases.It is therefore concluded than the average score for Taste and flavour of "Biscuits" differs significantly, which may be ascribed to different ratios of amaranth seeds flour and watermelon seeds flour in "Biscuits".The result is supported by the findings of Singh (2009). The result obtained showed that the incorporation of bajra and maize flour up to 15% was acceptable and improved the taste and flavour of "Biscuits", but at 20% of incorporation level bajra flour at high level made the product crunchy, it may be due to low gluten and high fiber content. The ANOVA shows that there is significant difference between the control and treatments of overall acceptability indicating that the addition of different proportions of amaranth seeds flour and watermelon seeds flour affect the overall acceptability of the prepared product, the overall acceptability improve and becomes more acceptable as the amount of amaranth seeds flour and watermelon seeds flour increases. On comparing the average scores for "Biscuits" from different treatments using critical difference the variations in the "Biscuits" can seen as the difference in the mean value of T2, T3 (2.51); was greater than CD (1.26) therefore the difference was significant. The difference in the mean value of T1, T3 (1.60); was greater than CD, (1.26) therefore the difference was significant. The difference in mean value of T0, T3 (1.47) was greater than CD, (1.26) therefore the difference was significant. It is therefore concluded that the average score for overall acceptability of "Biscuits" differ significantly, which may be ascribed to different ratios of amaranth seeds flour and watermelon seeds flour in "Biscuits". The result is supported by the findings of Marwein et al., (2010) wherein the mean scores of drop "Biscuits" in relation to overall acceptability, which indicate that the treatment T2 (8.35) scored maximum followed by treatment T1 and T3 at 8.70 and T0 (7.87) respectively. So it can be concluded that the addition of 60% cassava and 10% pumpkin flour improved the overall acceptability of drop "Biscuits".

The table 2 shows the mean scores of "Mathri" in relation to colour which indicates that T2 (wheat flour refined + amaranth seeds flour + watermelon seeds flour 70:20:10) had the highest score followed by T0 (wheat flour refind 100), T1 (wheat flour refined + amaranth seeds flour + watermelon seeds flour 80:10:10) and T3 (wheat flour refined +amaranth seeds flour + watermelon seeds flour 60:30:10) respectively. Scoring shows that the treatment T2 was liked very much while control and T0, T1, and T3 were moderately liked by the panel of judges.The texture of "Mathri" clearly indicates that the treatment T2 had the highest score for the texture of "Mathri" T0, T1 and T3 respectively.The mean score of "Mathri" in relation to taste and flavour was obtained by T0 and T1, T2, T3 respectively indicating that T2 gave the best taste and flavour to, "Mathri". The mean scores of "Mathri" in relation to overall acceptability indicate that the treatment T2 scored maximum followed by treatment T0.T1 and T3 respectively. It is seen that addition of 20% amaranth seeds flour and 10% watermelon seeds flour in the treatment T2 improved overall acceptability of "Mathri".The result is supported by the findings of Anu et al. (2007) prepared Biscuits sweet Biscuits (A) and sweet and salty Biscuits (B) using the flour of refined wheat, blanched pearl millet (pennicitium glacicum L.) and green gram phaseolusaureus) in the ratio of 50 percent, 40 percent, 10 percent (Type 1) and 30:60:10 (Type 2) and control containing 100 percent refined wheat flour. Both types of Biscuits are liked very much by the panelist. The ANOVA shows that the calculated value of F (25.27) was higher than the table value F (4.76) at 5% probability level. This shows that there is significant difference between the control and treatments, colour becomes golden brown and more acceptable as the amount of amaranth seeds flour and watermelon seeds flour increases. It is therefore concluded that the average score for colour of "Mathri" differ significantly. The result is supported by the findings of Singh et al., (2009) wherein the difference in the mean value of (T0 and T3), (T1 and T3), (T1 and T4), (T2 and T3) were less than C.D. 0.49 therefore the difference was significant. The ANOVA shows that there is significant difference between the control and

treatments of texture indicating that the addition of different proportions of amaranth seeds flour and watermelon seeds flour affect the texture of the prepared product, the texture becomes crunchy and more acceptable as the amount of amaranth seeds flour and watermelon seeds flour increases. On comparing the average scores for "Mathri" from different treatments using critical difference. the variations in the "Mathri" can seen as the difference in the mean value of T2, T3 (2.27); T2, T1 (0.8) was greater than CD (0.70) therefore the difference was significant. The difference in the mean value of T0, T3 (1.6); was greater than CD (0.70) therefore the difference was significant. The difference in mean value of T1, T3 (1.47) was greater than CD, (0.70) therefore the difference was significant. It is therefore concluded that the average score for body and texture of "Mathri" differ significantly, which may be ascribed to different ratios of amaranth seeds flour and watermelon seeds flour in "Mathri". The result is supported by the findings of Watters (2007) explained that the defatted peanut, soybean and field pea flour cover used to replace 10, 20 and 30 percent of the wheat flour in sugar cookies. The ANOVA shows that there is significant difference between the control and treatments of taste and flavour indicating that the addition of different proportions of amaranth seeds flour and watermelon seeds flour affect the taste & flavour of the prepared product, the taste & flavour becomes salty and more acceptable as the amount of amaranth seeds flour and watermelon seeds flour increases. On comparing the average scores for "Mathri" from different treatments using critical difference in table 4.2. (f). The variations in the "Mathri" can be seen as the difference in the mean value of T2, T3 (2.27); T2, T1 (0.74) and T2, T0 (0.94) was greater than CD (0.77) therefore the difference was significant. It is therefore concluded than the average score for Taste and flavour of "Mathri" differs significantly, which may be ascribed to different ratios of amaranth seeds flour and watermelon seeds flour in "Mathri" .The ANOVA that there is significant difference between the control and treatments of overall acceptability indicating that the addition of different proportions of amaranth seeds flour and watermelon seeds flour affect the overall acceptability of the prepared product, the overall acceptability improve and becomes more acceptable as the amount of amaranth seeds flour and watermelon seeds flour increases. The variations in the "Mathri" can be seen as the difference in the mean value of T2, T3 (2.45); T2, T0 (1.07) and T2, T1 (0.85) was greater than CD (0.58) therefore the difference was significant. The difference in the mean value of T1, T3 (1.6); was greater than CD, (0.58) therefore the difference was significant. The difference in mean value of T0, T3 (1.38) was greater than CD, (0.58) therefore the difference was significant. It is therefore concluded that the average score for overall acceptability of "Mathri" differ significantly, which may be ascribed to different ratios of amaranth seeds flour and watermelon seeds flour in "Mathri". Boobier W.J. (2007) studied physico- chemical properties and functional properties of the buckwheat flour had higher least gelation concentration (32 percent) as compared to wheat flour (20 percent) the concentration of buckwheat flour increased, spread ratio of Biscuits decreased.

The table 3 and Figure 3 shows the mean scores of "Laddoo" in relation to colour which indicates that T2 (semolina + amaranth seeds + watermelon seeds 70:20:10) had the highest score followed by T0 (Amaranth seeds 100), T1 (semolina + amaranth seeds + watermelon seeds 80:10:10) and T3 (semolina + amaranth seeds + watermelon seeds 60:30:10) respectively. Scoring shows that the treatment T2 was liked very much while control and T0, T1, and T3 were moderately liked by the panel of judges.The texture of "Laddoo" clearly indicates that the treatment T2 had the highest score for the texture of "Laddoo" T0, T1 and T3 respectively.The mean score of "Laddoo" in relation to taste and flavour was obtained by T0 and T1, T2, T3 respectively indicating that T2 gave the best taste and flavour to, "Laddoo".The mean scores of "Laddoo" in relation to overall acceptability indicate that the treatment T2 scored maximum followed by treatment T0.T1 and T3 respectively. It is seen that addition of 20% amaranth seeds and 10% watermelon seeds in the treatment T2 improved overall acceptability of "Laddoo". The ANOVAshows that the calculated value of F (13.63) was higher than the table value F (4.76) at 5% probability level. This shows that there is significant difference between the control and treatments of colour indicating that the addition of different proportions of amaranth seeds and watermelon seeds affect the colour of the prepared product, the colour becomes lightly darker and more acceptable as the amount of amaranth seeds and watermelon seeds increases.The result is

supported by the findings of Singh et al., (2011). On comparing the average scores for "Laddoo" from different treatments using critical difference it was found that the variations in the "Laddoo" can be seen as the difference in the mean value of T2 T3 (2.27); T2,T1 (1.2); T2,T0 (1.4) was greater than CD (0.30) therefore the difference was significant. The difference in the mean value of T0, T3 (0.87); was greater than CD, (0.30) therefore the difference was significant. The difference in mean value of T1, T3 (1.07) was greater than CD, (0.30) therefore the difference was significant. It is therefore concluded that the average score for overall acceptability of "Laddoo" differ significantly, which may be ascribed to different ratios of amaranth seeds and watermelon seeds in "Laddoo". The ANOVA shows that the calculated value of F (52.4) was higher than the table value F (4.76) at 5% probability level. This shows that there is significant difference between the control and treatments of texture indicating that the addition of different proportions of amaranth seeds and watermelon seeds affect the texture of the prepared product, the texture becomes fragile and more acceptable as the amount of amaranth seeds and watermelon seeds increases.On comparing the average scores for "Laddoo" from different treatments using critical difference the variations in the "Laddoo" can be seen as follows The difference in the mean value of T2, T3 (2.27); T2, T1 (1); T2, T0 (1.33) was greater than CD (0.44) therefore the difference was significant. The difference in the mean value of T0, T3 (0.94); was greater than CD, (0.44) therefore the difference was significant. The difference in mean value of T1, T3 (1.27) was greater than CD, (0.44) therefore the difference was significant. It is therefore concluded that the average score for texture of "Laddoo" differ significantly, which may be ascribed to different ratios of amaranth seeds and watermelon seeds in "Laddoo". The result is supported by the findings of Singh et al., (2011). The result obtained showed that the calculated value of F (2.67) was higher than the table value of F (3.01) at 5% probability level. It indicates that the treatment have significant influence on the texture of "Laddoo" from mahua flower flour, soya and wheat flour. The ANOVA table 4.3. (e) Shows that the calculated value of F (28.5) was higher than the table value F (4.76) at 5% probability level. This shows that there is significant difference between the control and treatments of taste and flavour indicating that the addition of different proportions of amaranth seeds and watermelon seeds affect the taste & flavour of the prepared product, the taste & flavour becomes delicious and more acceptable as the amount of amaranth seeds and watermelon seeds increases. On comparing the average scores for "Laddoo" from different treatments using critical difference in table 4.3. (f). the variations in the "Laddoo" can be seen as the difference in the mean value of T2, T3 (2.34); T2, T1 (1.07); T2,T0 (1.54) was greater than CD (0.63) therefore the difference was significant. The difference in the mean value of T0, T3 (0.8); was greater than CD, (0.63) therefore the difference was significant. The difference in mean value of T1, T3 (1.27) was greater than CD, (0.63) therefore the difference was significant. It is therefore concluded that the average score for taste and flavour of "Laddoo" differ significantly, which may be ascribed to different ratios of amaranth seeds and watermelon seeds in "Laddoo". The ANOVA shows that the calculated value of F (42.35) was higher than the table value F (4.76) at 5% probability level. This shows that there is significant difference between the control and treatments of overall acceptability indicating that the addition of different proportions of amaranth seeds and watermelon seeds affect the overall acceptability of the prepared product, the overall acceptability improve and becomes more acceptable as the amount of amaranth seeds and watermelon seeds increases.On comparing the average scores for "Laddoo" from different treatments using critical difference. The variations in the "Laddoo" can be seen as the difference in the mean value of T2, T3 (2.32); T2, T1 (1.09); T2, T0 (1.41) was greater than CD (0.50) therefore the difference was significant. The difference in the mean value of T0, T3 (0.90); was greater than CD, (0.50) therefore the difference was significant. The difference in mean value of T1, T3 (1.23) was greater than CD, (0.50) therefore the difference was significant.It is therefore concluded that the average score for overall acceptability of "Laddoo" differ significantly, which may be ascribed to different ratios of amaranth seeds and watermelon seeds in "Laddoo".

B. AVERAGE NUTRIENT CONTENT OF PREPARED PRODUCTS

On the basis of sensory evaluation the best treatment from each treatment of prepared i.e. Treatment T2 with wheat flour refined or semolina, amaranth seeds or its flour, and watermelon seeds

or its flour in the ratio of 70:20:10 were identified and chemical analysis of those treatments T0 and T2 were carried out with the reference of ash, moisture, protein, fat, carbohydrate, calcium, and iron content.

Table 4 shows the nutrient concentration per 100g of the product. This shows that the moisture content of biscuits T0 (4.6) was high in comparison to, T2 (4.5). The ash content of T0 (2.73) was high in comparison to, T2 (2.47). The protein content of T2 (14.46) was high in comparison to, T0 (7.2). Fat content of T2 (25.67) was high in comparison to, T0 (20.79). Calcium content of T2 (59.90) was high in comparison to, T0 (17.43). Iron content of T2 (5.01) was high in comparison to, T0 (1.90). Carbohydrate content of T0 (63.21) was high in comparison to, T2 (59.90). The fat, protein, calcium, and iron content was increased in T2 as compared to T0, this is due to addition of amaranth seeds flour and watermelon seeds flour in treatment T2. The result is supported by the findings of Sampaio et al. (2009) Moisture adsorption isotherms from a new "Biscuits" considered as functional food were determined using a gravimetric static method at 25 and 40C and over a range of relative humidity from 0.112 to 0.903. The "Biscuits" had 2.5, 3.3, 10.0 and 31.0% of ash, fiber, protein and fat, respectively, and 4.7% moisture content. The equilibrium moisture content of the "Biscuits" (kg/kg) increased when the storage temperature at any given water activity (Aw) was reduced. The experimental data were analyzed using different models, namely Guggenheim–Anderson–de Boer (GAB) (three-parameter relationships), Henderson and Oswin (both models with two parameters), which exhibited a sigmoid shape at the studied temperatures. The maximum isosteric heat of sorption was 21.6 kJ/mol, which exponentially decreased when the moisture content was increased. The GAB model was found to be the most suitable for describing the adsorption characteristics at the temperature and Aw range studied, according to the relative error and the coefficient determination. In Mathari the moisture content of T0 (5.99) was high in comparison to, T2 (5.76). The ash content of T2 (3.37) was high in comparison to, T0 (3.36). The protein content of T2 (11.10) was high in comparison to, T0 (8.63). Fat content of T2 (38.56) was high in comparison to, T0 (29.56). Calcium content of T2 (53.95) was high in comparison to, T0 (17.34). Iron content of T2 (3.82) was high in comparison to, T0 (1.5). Carbohydrate content of T2 (38.83) was high in comparison to, T0 (50.27). The protein, fat, calcium and iron content was increased in T2 as compared to T0, this is due to addition of amaranth seeds flour and watermelon seeds flour in treatment T2. The result is supported by the findings of John H. Muyonga et al. (2008) reported that amaranth grains are high in protein and the proteins are of high quality. The grains are also rich in unsaturated fatty acids, especially linoleic acid, and contain substantial levels of essential micronutrients. Grain amaranth was also found to make acceptable soups, fried and baked products. Feeding trials so far show that grain amaranth leads to improved growth among children. The moisture content of laddo T2 (6.66) was high in comparison to, T0 (5.32). The ash content of T2 (7.29) was high in comparison to, T0 (6.46). The protein content of T2 (13.59) was high in comparison to T0 (9.70). Fat content of T0 (9.30) was high in comparison to, T2 (7.30). Calcium content of T2 (100.1) was high in comparison to, T0 (17.40). Iron content of T2 (3.33) was high in comparison to, T0 (1.2). Carbohydrate content of T2 (64.49) was low in comparison to, T0 (65.033). The protein, calcium and iron content was increased in T2 as compared to T0, this is due to addition of amaranth seeds and watermelon seeds in treatment T2. The result is supported by the findings of Kaul et al.(2011) reported that watermelon (Citrullus vulgaris) seeds are high in protein and fat, on enriching protein, it can find application as a protein source in various food formulations. The seeds were a moderate source of iron and zinc. The percent bio accessibility of all the minerals were found to correlate (R ¼ 0.97e0.99) with the concentration of phytate, tannin and oxalate contents.

C. COST OF THE PRODUCTS BASED ON THE RAW MATERIALS

Cost is very important factor, which affects the marketability of the products and needs to be considered while manufacturing of the food products. It is the basis for price fixation and determining the profit on the cost of production. The cost has been calculated on the basis of prevailing price of raw materials. The cost of the "Biscuits" per 100gm of dry ingredients at the prevailing cost of the raw materials was Rs.6.53 T0 control, Rs 9.53 for T1, Rs. 11.07 for T2, and Rs. 12.45 for T3. This shows that as the incorporation level of amaranth seeds flour and watermelon seeds flour increased the cost also increased marginally. The cost of the "Mathri" per

100gm of dry ingredients at the prevailing cost of the raw materials was Rs.12.27 T0 control, Rs 15.43 for T1, Rs. 16.81 for T2, and Rs. 18.19 for T3. This shows that as the incorporation level of amaranth seeds flour and watermelon seeds flour increased the cost decreased marginally. The cost of the "Laddoo" per 100g of RAW ingredients at the prevailing cost of the raw materials was Rs.6.42 T0 control, Rs 9.54 for T1, Rs. 10.9 for T2, and Rs. 12.26 for T3. This shows that as the incorporation level of amaranth seeds and watermelon seeds increased the cost increased marginally.

Conclusion

It is concluded that amaranth seeds, watermelon seeds and their flour can be successfully incorporated in "Biscuits", "Mathri" and "Laddoo". On the basis of sensory evaluation T2 (amaranth seed flour and watermelon seed flour in the ratio of 20:10) as found best in "Biscuits", "Mathri" and "Laddoo"with regards colour and appearance, body and texture, taste and flavor and overall acceptability. Nutritive value of the prepared products indicate that protein, fat, carbohydrate, calcium and iron content increased in enriched "Biscuits", , "Mathri" and "Laddoo" as compared to control. Cost of the three products namely "Biscuits" (Rs. 6.53-12.45), "Mathri" (Rs.12.27-18.19) "Laddoo" (6.42-12.26) increased significantly as the ratio of amaranth seeds, watermelon seeds and their flour increased.

Recommendation

Incorporation of different proportions of amaranth seeds flour and watermelon seeds flour for value addition in traditional recipes can be encouraged and popularized in order to improve intake of protein, fat, calcium, carbohydrate and iron.These products can also be helpful for providing variety in the daily dietaries in addition to their nutritional benefits and the amaranth seeds flour and watermelon seeds flour can be used out of season as well.

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Tables

TABLE 1 AVERAGE SENSORY SCORE OF DIFFERENT PARAMETERS IN CONTROL AND TREATED SAMPLE OF "BISCUITS".

Parameters	T0 Mean± SE	T1 Mean±SE	T2 Mean±SE	T3 Mean±SE	Statistical Analysis
Colour and Appearance	7.46±0.06	8±0.11	8.86±0.06	6±0.23	F =62(4.76) S* CD=1.67
Body and Texture	7.6±0.29	7.4±0.06	8.46±0.06	6.06±0.24	F =4.90(4.76) S* CD=1.56
Taste and Flavor	7.6±0.11	7.6±0.06	8.53±0.24	6.2±0.13	F=43.77(4.76)S* CD=2.26
Overall Acceptability	7.57±0.14	7.7±0.04	8.61±0.05	6.1±0.15	F=80.75(4.76) S* CD=1.26

TABLE 2 AVERAGE SENSORY SCORES OF DIFFERENT PARAMETERS IN CONTROL AND TREATED SAMPLE OF "MATHRI"

	T0	T1	T2	T3	
Parameters	Mean± SE	Mean±SE	Mean±SE	Mean±SE	**Statistical Analysis**
Colour and appearance	7.2±0.30	7.73±0.24	8.6±0.11	5.86±0.17	F =25.27(4.76) S* CD=0.78
Body and texture	7.73±0.37	7.6±0.23	8.4±0	6.13±0.06	F=22(4.76) S* CD=0.78
Taste and flavor	7.46±0.40	7.66±0.17	8.4±0.13	6.13±0.06	F=17.59(4.76) S* CD=0.77
Overall Acceptability	7.43±0.32	7.65±0.13	8.50±0.02	6.05±0.07	F=35.57(4.76) S* CD=0.58

TABLE 3 AVERAGE SENSORY SCORES OF DIFFERENT PARAMETERS IN CONTROL AND TREATED SAMPLE OF "LADDOO".

Parameters	T0	T1	T2	T3	**Sensory Acceptability**
	Mean± SE	Mean±SE	Mean±SE	Mean±SE	
Colour and Appearance	7.13±0.29	7.33±0.13	8.53±0.06	6.26±0.29	F =13.63(4.76) S* CD=0.30
Body and Texture	7.2±0.11	7.53±0.17	8.53±0.13	6.26±0.17	F=52.4(4.76) S* CD=0.44
Taste and Flavor	7.06±0.13	7.53±0.13	8.6±0.11	6.26±0.40	F=28.5(4.76) S* CD=0.63
Overall Acceptability	7.12±0.16	7.45±0.06	8.54±0.05	6.22±0.26	F=42.35(4.76) S* CD=0.50

TABLE 4 THE AVERAGE NUTRIENT CONTENT OF "VALUE ADDED SNACKS" PER 100 G.

NUTRIENTS	**Biscuits**		**Mathari**		**Laddo**	
	T0	T2	T0	T2	T0	T2
	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Moisture %	4.6±0.16	4.5±0.15	5.99±0.11	5.76±0.28	5.32±0.071	6.66±0.416
Ash (g)	2.73±0.18	2.47±0.07	3.36±0.166	3.37±0.255	6.46±0.212	7.293±0.116
Protein (g)	7.2±0.26	14.46±0.142	8.63±0.24	11.10±0.06	9.70±0.14	13.59±0.220
Fat (g)	20.79±0.29	25.67±0.22	29.56±0.68	38.56±0.203	9.30±0.29	7.30±0.26
Total carbohydrate (g)	63.21±0.06	59.90±0.375	50.27±0.032	38.83±0.55	65.033±0.812	64.49±0.61
Calcium (mg)	17.43±0.573	59.90±0.375	17.34±0.08	53.95±0.135	17.40±0.492	100.1±0.32
Iron (mg)	1.90±0.053	5.01±0.089	1.5±0.192	3.82±0.27	1.2±0.057	3.33±6.081