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Enrichment of weaning food with Anthocyanin and Iron

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Abstract
Weaning foods are generally prepared using many different ingredients which are rich in nutritional values that help in the growth of infants along with breast milk. This type of food generally consists of a combination of cereal, pulse and fruit or a vegetable. The present study is carried out on enrichment of weaning food with anthocyanin and iron using ingredients- white rice, black rice, redgram, carrot, spinach and ajwain. The ingredients are mixed in the ratio of T_1(69:1:20:5:4:1), T_2(68:2:20:5:4:1), T_3(67:3:20:5:4:1), T_4(66:4:20:5:4:1) and T_5(65:5:20:5:4:1) prepared with the order (white rice: black rice: redgram: carrot: spinach: ajwain). Sensory evaluation is carried out for each formulation with respect to control sample and the samples with good scores are tested for nutritional evaluation. Based on the physico-chemical and sensory analysis carried out for the samples T2, T3, T4 and T5 have more amount of anthocyanin and iron compared to T1 and control samples.

Keywords: weaning food, black rice, anthocyanin, iron

Introduction

Weaning foods are given to infants from the age of 6months as the growth and activities of them increases during which breast feeding alone so supplement of additional foods along with good weaning practices becomes essential for infants physical and mental growth [1]. Foods that can be given should be boiled and mashed vegetables like carrot, potato and green leafy vegetables; starchy foods with rich carbohydrates like potato, rice, cereals and oats; boiled and mashed pulses and legumes; ripe and mashed fruits like apple, banana; dairy products like cheese and yogurt. Malted foods can also feed as they reduce the viscosity of food allowing the infant to take more food at a time. High fat and fried foods are to be strictly avoided in the initial stages of weaning as the digestive system of the infants do not support for digestion and cause indigestion symptoms like diarrhea, stomach ache [2, 3, 4]. Good weaning practices help the healthy growth and makes the infant free from malnutrition. Good weaning practices include breast feeding for a period of two years along with nutritionally balanced supplements [5, 6]. In India mostly homemade and commercially weaning foods are used [7].

Rice (Oryza sativa) is a staple product belonging to Poaceae family. This is grown in many parts of the world and consumed majorly by South Asian countries like China, India, Indonesia and Bangladesh. These countries have both import and export trades with other countries. Rice is used for preparing many products including rice flour, rice flakes, rice bran oil, rice syrup and weaning foods. This is a rich source of carbohydrates, thiamine with no fat [8].

There are different types of rice which are pigmented like red rice, black rice, dark purple rice which are rich in micro nutrients compared to macro nutrients [9]. The pigments in rice are due to the presence of anthocyanins which are a rich source of anti-oxidants. The number of anthocyanins is rich in black rice compared to other types of pigmented rice. Oryza sativa L. indica (Black rice) is also known as purple rice or forbidden rice. This type of rice is mostly consumed in China, Malaysia, Phillipines. The anthocyanins are pigmented flavanoid compounds that give blackish purple color to the rice. These metabolites exert a positive health effect resulting in anti- inflammatory, anti- cancer and anti- oxidative properties in food in turn helps in improving the immune system [10, 11, 12].

This is also rich in iron, calcium, magnesium, Zinc, Niacin, Thiamine, Riboflavin and a source of protein [13, 14].

Cajanas cajana (Redgram) is the mostly used household pulse which comprises the protein content of the daily diet. There are many other pulses like green gram, Bengal gram and legumes like soya bean, lentils, fava beans etc., Redgram is given to children to add protein content to the diet and also make the taste familiar to the infant. It is a rich source of Calcium, Magnesium and Potassium [15].

Vegetables are important parts of human diet. Generally, they are plant or plant parts that are rich in vitamins and minerals. Usually, vegetables like tubers and green leafy vegetables are widely used only after proper blanching and completely mashed. Among tubers carrot, beetroot, radish, sweet potato etc., are widely used. *Daucus carota* (Carrot) is a root vegetable which is usually orange in color due to the presence of β- carotene which is the precursor for Vitamin A, rich source of fiber, vitamin B6 which helps in improvement of skin, hair, eye and liver health [16, 17, 18].

Spinacia oleracea (Spinach) is a green leafy vegetable which is rich source of vitamin A, vitamin C and Potassium. This helps acts on anti- inflammatory, night blindness, improve bone strength, keeps immunity high, help with gastric problems [19, 20].
*Trachyspermum ammi (L) Sprague (*Ajwain) is a herb belonging to Apiaceae family which have numerous medicinal uses. This is given to infants as it acts on the digestive system in decreasing the levels of any toxic substances and help in easy digestion of food [21].
The objective of this project is selection of raw material, formulation of weaning food and study of sensory, anthocyanin and iron components of weaning foods.

Materials and Methods

Procurement of raw material

The raw materials required for the preparation of complementary mix are black rice, red gram, carrot, spinach and ajwain are procured from the local market of Kakinada.

Preparation of ingredients

Sample treatment for white rice: White rice is procured from the market, soaked for 2to 3 hours, shade dried to remove the excess water, dry roasted and is coarsely grounded.

Sample treatment for Black rice: Black rice is procured from the market, soaked for 3 to 4 hours, shade dried to remove the excess water, dry roasted and is coarsely grounded.

Sample treatment for Redgram: Redgram is procured from the market, soaked for 2 to 3 hours, shade dried to remove the excess water, dry roasted and made into powder.

Sample treatment for carrot: Carrot is procured from the market, grated using a grater, dip blanched in water for 4 minutes and tray dried at 65^{o}C for 4 hours.

Sample treatment for Spinach: Spinach is procured from the market, leaves are separated from the stems, cleaned, steam blanched for 4 minutes and tray dried at 65oC for 2 hours.

Sample treatment for Ajwain: Ajwain is procured from the market, cleaned and dry roasted.

Table 1: Blanching time and temperatures

S.No	Vegetables	Blanching Medium	Blanching time (minutes)	Blanching temperature (^{o}C)
1	Carrot	Water	4	80-100
2	Spinach	Steam	4	90-95

Preparation of mix

The composition used in this study is based on the study conducted using rice flour (cereal), soyabean (legume), irish potatoes (tuber), carrot (vegetable) and crayfish [22]. But from table 2 in my study black rice and spinach along with a herb is used instead of tuber and crayfish, soyabean is replaced with redgram.

Table 2: Formulation of samples

Samples	White rice (g)	Black rice (g)	Red gram (g)	Carrot (g)	Spinach (g)	Ajwain (g)
Control	70	-	20	5	4	1
T_1	69	1	20	5	4	1
T_2	68	2	20	5	4	1
T_3	67	3	20	5	4	1
T_4	66	4	20	5	4	1
T_5	65	5	20	5	4	1

Net weight of each sample: 100g

All the prepared ingredients are mixed in proportions and cooked in 200ml of boiling water for 10 minutes.

Physico- chemical/ proximate analysis carried out for samples

To test the quality and nutritional value a series of methods are used. These are of two types like proximate analysis and sensory analysis. Proximate analysis includes moisture content. Estimation of total carbohydrates, proteins, ash content, energy, estimation of micronutrient like iron and pigment components like anthocyanins. Moisture content of the product is estimated using hot air oven method which is an AOAC method of analysis. Total carbohydrates are estimated using phenol sulphuric acid method in which glucose in dehydrated to hydroxymethyl furfural and with phenol gives green color and value is given using spectrophotometry. Protein content is calculated using Kjeldahl method of acid digestion using sulphuric acid [23].Total anthocyanin content

is estimated using spectrophotometry [24]. Iron content is estimated using atomic absorption of spectrophotometry [25]. Energy is calculated using the values of carbohydrates and proteins. Ash content is determined using dry ashing method (AOAC method). Sensory analysis is nothing but studying the sensory characteristics of the product using 9 points Hedonic scale [26].

Results

Data for proximate analysis

From the table 3 the proximate analysis for control and test samples are estimated to be energy of 309.498-335.804 kcal, carbohydrates of 66.751-69.056gm, protein of 9.775-9.830g, anthocyanin content of 0-17.2 mg, iron content of 0.12-100.12mg, moisture content of 6.05-7.92gm and ash content of 1.02-1.98gm. It is observed that from the samples T_1 to T_5 the amount of energy is decreased from T_1 to T_3 due to the decrease in amount of white rice and increased from T_3 to T_5 because the amount of black rice is increased which accounted in the increase of energy. The amount of carbohydrate also decreased from T_1 to T_5 due to decrease in the amount of white rice. The amount of protein is increased from T1 to T5 due to to effective usage of black rice and red gram which are a good source of proteins. The amount of anthocyanin gradually increased in each sample with increase in amount of black rice. From the table it can be observed that the control sample contain null amounts of anthocyanins whereas the samples contain certain amounts of anthocyanins. The iron content in control sample is of 0.12mg where as in the test samples it ranges from 20.123-100.12mg. The increase in iron content is due to the usage of black rice and spinach. The moisture content is 6.384-7.502gm which is 1-2% more than the average moisture content of 5%. The ash content increases from 1.346-1.985gm compared to control sample of 1.021gm. When the anthocyanin content is of control and sample ranges from 0-17.282mg and the RDA value for athocyanin is 4mg/day [11]. The samples T2, T3, T4 and T5 are more than the RDA value. The iron content of samples along with control ranges from 0.12-100.12mg where the iron content is more than the RDA value i.e., 5mg/day [27].

Table 3: Proximate Analysis of Weaning food

S. No	Sample	Energy (kcal)	Carbohydrates (g)	Protein (g)	Anthocyanin (mg)	Iron (mg)	Moisture content (g)	Ash content (g)
1	Control	315.384	69.056	9.79	0	0.12	6.051	1.021
2	T1	313.48	68.595	9.775	1.273	20.123	6.384	1.346
3	T2	311.76	68.134	9.806	5.245	40.152	7.024	1.562
4	T3	309.498	67.673	9.814	9.278	60.128	6.783	1.693
5	T4	321.648	67.212	9.822	13.245	80.120	7.047	1.824
6	T5	335.804	66.751	9.83	17.282	100.12	7.502	1.985

g: gram; mg: milligram; kcal: Kilocalorie

Sensory Analysis

The sensory evaluation is carried out with a team of 7 semi trained panel members. The evaluation procedure is carried out using 9point hedonic scale in which attributes like color, taste, texture and overall acceptability for the product, scores are provided by each panel member. The results are calculated using ANOVA in which all the samples are significant with ($p<0.05$) so the samples are accepted and are having less risk.

The values given in the table 4 are based on the average of score given by 7 members and the significance of the product is calculated using ANOVA with *p*-value as T1=0.01, T2=0.04, T3=0.02, T4=0.01 and T5=0.02. All the samples are significant with the control sample as all the values are less than 0.05.

From the table 4 color of T1, T3 and T5 have similar color with control compared to T2 and T4 have less color acceptance. Taste of T3 is good compared to control and other samples. Texture of T3 is good compared to control and other samples and the overall acceptability of T3 is good compared to control and other samples

Table 4: Sensory analysis of the samples with control

	Control	T1	T2	T3	T4	T5
Color	6.714	6.714±0.016	6.571±0.049	6.714±0.027	6.571±0.017	6.714±0.021
Taste	6.857	6.714±0.016	6.571±0.049	7.142±0.027	6.571±0.017	6.428±0.021
Texture	6.714	6.428±0.016	6.571±0.049	7±0.027	6.428±0.017	6.142±0.021
Overall acceptability	6.714	6.571±0.016	6.542±0.049	6.914±0.027	6.442±0.017	6.357±0.021

Discussion

From table 3 the amount of energy of T_1, T_2 and T_3 is low compared to control sample is due to the decrease in amount of white rice and low amounts of black rice whereas in T_4, T_5 the energy is more compared to control sample. Due to the constant decrease in amount of white rice there is a decrease in carbohydrate. Due to the usage of black rice there is constant increase in protein content. The amount of anthocyanin and iron increase.

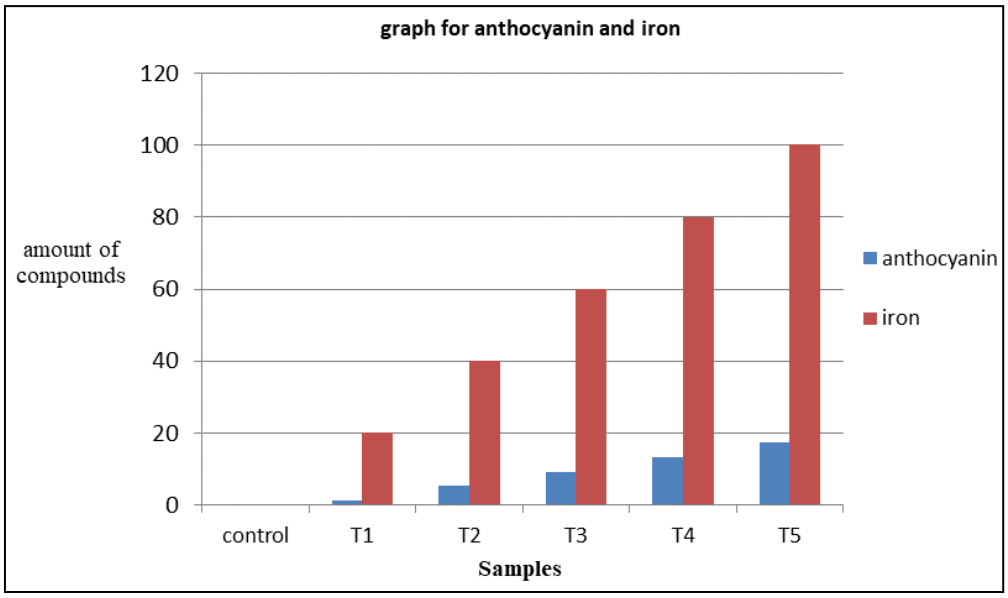

Fig 1: graph representing anthocyanin and iron content in samples

Conclusion

The present study was conducted on "Enrichment of Weaning food with anthocyanin and iron". The preparation of this instant includes many ingredients (white rice, black rice, red gram, carrot, spinach and ajwain) in different proportions. Sensory analysis is conducted by providing samples to the sensory evaluators. From the results sample T3 has superior sensory qualities followed by T1 and T2 samples.

The physico- chemical analysis is conducted to all the samples of which T2, T3, T4 and T5 have superior quality of anthocyanin and iron content with increased amount of black rice. Formula diet with essential nutrients along with micro nutrients have become the part of our lifestyle. The instant mix of weaning food enriched with anthocyanin and iron is studied that the usefulness of black rice in supplementing reasonable source of anthocyanin (RDA 48% per day) and iron content (RDA 50% per day), along with carbohydrates and protein content.

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