

DEVELOPMENT OF VARIOUS FOOD PRODUCTS USING BLACK RICE AND ANALYZING THE PRODUCT ACCEPTABILITY BY SENSORY EVALUATION

¹J. Amala Reena, ²Dr. J. Sridevi

¹Student, ²Assistant Professor

^{1,2}Department of Nutrition and Dietetics.

PSG College of Arts and Science, Coimbatore, India.

ABSTRACT: Black rice is otherwise also known as forbidden rice which relatively have high anthocyanin content and antioxidant activities compared to other rice varieties. Black rice also has many health benefits which really makes it a golden rice. In India the cultivation of black rice is less compared to China, Japan and Thailand, Consumption of black rice by Indians is also low due to less cultivation and lack of awareness. Hence the most common south Indian sweet recipes, savorys, Brownies, cookies and ice cream are made by using 100% black rice. A total of fifteen products are developed using black rice and assessed for its anthocyanin content and antioxidant activity. All the developed products such as Brownie, Cookies, Ice cream, Ela Ada, Kinnathappam, Puttu, Bholi, Sweet seedai, Spice seedai, Murukku, Thattuvadai, Gulab Jamun, Payasam, Idly Podi and cutlet using black rice are compared with standard product available and it has been found that black rice food products are highly acceptable for consumption and highly nutritious because of its abundant health benefits. Black rice can be included in any type of processed food products, and it is highly recommendable for patients with diabetes.

Key Words: Black rice, Development of Food product, Diabetes, Health benefits.

I INTRODUCTION

Pigmented rice varieties are admired all over the world and have a history of Heritage. Black rice is a nutrient-rich variety of rice that is mainly cultivated in Asian countries. Black rice has been involved in the field of medicine other than cooking and fodder for cattle. It contains a high nutrient value and beneficial amino acids like lysine and tryptophan which possess lots of health benefits. Other than benefits black rice cultivation provides a path of entrepreneurship to many farmers. Black rice cultivation can generate great employment opportunities and producers can earn profit from the sale of black rice. (Agarwal, 2021). Black rice bran has more anthocyanin antioxidants than blueberries. However, black rice bran has more health benefits. It contains more fiber and vitamin E (another essential antioxidant) and less sugar than blueberries. Antioxidants can neutralize free radicals and can help to prevent oxidative damage. Studies show that antioxidant supplementation can exert a preventive effect against the development of serious conditions like cancer and may improve overall health. (Thanuja and Parimala Valli, 2018).

Black Rice as an Ingredient in Food Processing - The various positive health benefits of black rice and the presence of the black pigment-"Anthocyanin" makes black rice a wonder ingredient in food processing. The use of black rice in food processing can increase the nutritional profile of the food products being created with black rice and can also be converted into a functional food targeting a particular group of people (e.g., diabetic patients, obese people or people with high blood pressure and cardiac ailments). As black rice is not well known among the common people, its use in food processing will be novel as well as a healthy alternative to other common foods for the future generation.

Application of Black Pigment-"Anthocyanin" In Food Processing - Anthocyanins are a class of organic compounds belonging to the group of flavonoids, formed by the phenyl propanoic pathway. Anthocyanins have high antioxidant activity and wide variety of health benefits such as reducing the risk of developing cardiac diseases, obesity, diabetes, cancer and are used in the treatment of skin cancer or other skin related issues. Use of anthocyanin for food application can increase the nutritional profile and bioavailability of nutrients and also used for the development of functional foods. (Nitin and Roshini, 2020).

In this study we have formulated various commercially unavailable Food products using black rice as major ingredient. Various kind of Food products is developed using 100% Black rice and no other ingredient is used as binding agent.

II METHODOLOGY

"Development of various food products using Black rice and Analyzing the product acceptability by Sensory Evaluation" is done to introduce new products which are commercially unavailable in market using black rice as a major (100%) ingredient.

SELECTION OF INGREDIENTS:

The following ingredients listed in the table below for developed 15 products using Black rice are procured from the local market. Black rice, which is used as the main ingredient for product development, was procured from an organic shop.

Table 1: Ingredients selected for Food products developed using Black rice.

S. No	Product Name	Ingredients
1	Black rice Brownie	Black rice flour, Brownsugar, Butter, Cocoa powder, Dark Chocolate, Curd, Milk, Baking Powder.
2	Black rice Cookies	Black rice flour, Brown sugar, Butter, Baking powder.
3	Black rice incorporated icecream	Black rice flour, Milk (fullfat), Brown sugar.
4	Black rice Ela Ada	Black rice flour, Jaggery, Shredded coconut, salt, water, banana leaf, cardamon.
5	Kinnathappam	Black rice flour, Jaggery, coconut milk, cardamon, egg.
6	Puttu	Black rice flour, salt, water,coconut.
7	Bholi	Black rice flour, coconut, oil, jaggery, salt.
8	Sweet seedai	Black rice flour, Bengal gramflour, Brown sugar, Coconut oil (for frying)
9	Spice seedai	Black rice flour, Bengal gramfour, Chili powder, salt, Coconut oil for frying.
10	Murukku	Black rice flour, Bengal gramflour, Butter, omam,salt, chilli powder.
11	Thattuvadai	Black rice flour, Bengal gramflour, chilli powder, salt, Split Bengal gram dhal, curry leaves.
12	Gulab Jamun	Black rice flour, Milkpowder, Milk, Butter, Brownsugar, Water.
13	Payasam	Black rice (soaked), milk, ghee, Brownsugar, Raisins, Cashew nuts. Cardamom.
14	Idly Podi	Black rice (roasted) Sesame seeds, Urad dhal, red chili, Curry leaves





Procurement of raw material:







For the present study the Black rice was collected from the locally available market, Black rice was purchased as whole and not as flour. Other ingredients needed for preparation of food products such as butter, oil, dark chocolate, cocoa powder, spices, vegetables, brown sugar, nuts, raisins, and coconut were purchased from the local market of Coimbatore and stored in an appropriate atmosphere to avoid contamination. Perishable products like vegetables are purchased whenever they are needed from nearby stores as a fresh source.





Preparation of Food products using Black rice:

The processing method and preparation steps for all the 15 products that are developed usingblack rice are explained in the table below.

Table 2: Preparation procedure for the Developed Food products using Black rice:

Product Name	Preparation Steps	Images
Brownie	Sieve all the dry ingredients. Melt the chocolate and butter. Add curd and Brown sugar, mix it well. Add the sieved dry ingredients (Black rice flour, cocoa powder, baking soda) and nuts. Blend the mixture together. Pour it in a greased tray, bake at 145 degree Celsius for 40 minutes.	PLATE 1 – Black rice Brownie 
Cookies	Sieve the dry ingredients (Black rice flour, Cocoa powder) Melt the Butter and pour it into sieved ingredients. Make it into a dough, knead and cut into shapes. Bake it at 135-degree Celsius for 15min.	PATE 2 – Black rice Cookies 
Ice cream	Boil the milk till it thickens, use Black rice flour mixture as a thickening agent. Add Brown sugar, Blend/ Mix it in a mixer, refrigerate it.	Black rice ice cream
	Repeat the process 3 times.	
Ela Ada	Mix the Black rice flour with hot water and add salt. Make it into a dough and tap it flat using Banana leaf, Stuff it with Jaggery and coconut mixture, close it and steam it. Serve it along with Banana leaf.	PLATE 4- Ela Ada 

Kinnathappam	Mix the Black rice, Coconut milk, jaggery, egg and shredded coconut. Make it into a batter. Steam the batter, cut it into desired shapes (pieces).	PLATE 5 – Kinnathappam 
Puttu	Mix the Black rice flour by sprinkling hot water and add salt, mix it till breadcrumbs consistency. Steam it along with some shredded coconut.	PLATE 6 – Black rice Puttu 
Sweet seedai	Blend black rice, butter, and brown sugar. Make it into dough. Knead it, cut it into pieces and fry it using fresh oil.	PLATE – 7 Sweet Seedai 
Spice seedai	Mix Black rice, Butter, Chilli Powder, salt. Make it into dough. Form a small ball and fry it in fresh oil.	PLATE – 8 Spice Seedai 
Thattuvadai	1) Mix Black rice, Chilli Powder, salt, and curry leaves.	PLATE – 9 Thattuvadai
	Add soaked split Bengal gram dhal. Form the dough, make a few balls from the dough, and tap it flat. Fry it in fresh oil.	
Murukku	Mix Black rice, Bengal gram dhal, Chilli powder, salt, omam, Butter, Split Bengal gram dhal. Make it into dough. Place it in an extruder and extrude it, fry it in fresh oil.	 PLATE- 10 Murukku

<p>Bliho</p>	<p>Make the dough with black rice, salt, water, and coconut oil, Rest the dough for 1 hour. Roll it with roller, stuff it with Shreddedcoconut and Jaggery, close it and roll it again. Cook it on both sides by turning onto the other side.</p>	<p>PLATE – 11 Bholi</p> 
<p>Gulab Jamun</p>	<p>Mix black rice flour along with milk powder and butter. Knead it into a soft dough. Roll it into small balls, fry it in fresh oil without any cracks. Leave the balls to be soaked in sugar syrup prepared using brown sugar for 1 hr.</p>	<p>PLATE – 12 Black rice Gulab Jamun</p> 
	<p>cashews, and add ghee.</p>	
<p>Idly Podi</p>	<p>Roast the Sesame seeds, black rice, Red Chilly, Curry leaves,</p>	<p>PLATE 14 – Black rice incorporated idly podi</p>
	<p>Urad dhal and grind it into a powder.</p>	
<p>Cutlet</p>	<p>Cook all the vegetables (carrot, pea and potato), smash it and cook it along with salt, chilli powder, garlic paste, Coriander powder. Stuff it inside a dough made with Maida and black rice, over coat it with breadcrumbs and black rice can also be used as dipping agent. Fry it using fresh oil.</p>	<p>PLATE 15 – Black rice cutlet.</p> 

Sensory Evaluation:

Sensory evaluation is done for all the 15 products developed, by 50 semi trained panel members, 9-point hedonic scale is used as score card for analysis. The image of doing sensory evaluation with panel members is presented as plate 16



PLATE 16 – Sensory Evaluation of Products developed from Black rice by panelmembers.

II RESULTS AND DISCUSSION

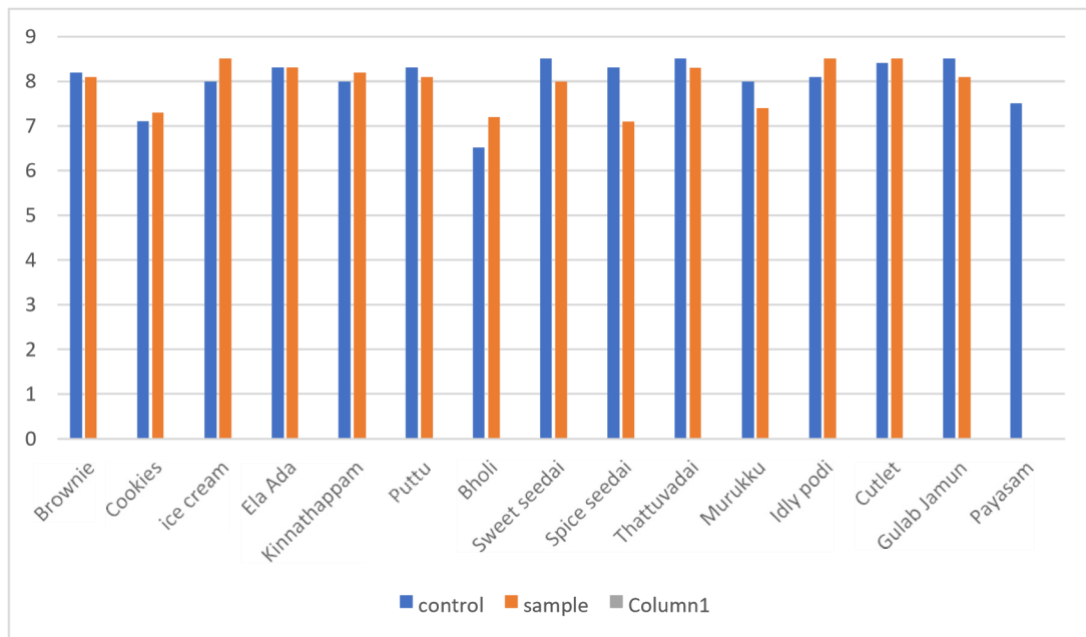
- Overall mean acceptability for Appearance of Black rice food products.
- Overall mean acceptability for Taste of Black rice food products.
- Overall mean acceptability for Flavor of Black rice food products.
- Overall mean acceptability for Texture of Black rice food products.
- Overall mean acceptability for Aroma of Black rice food products.
- Overall acceptability of Black rice food products.

Overall mean acceptability for Appearance of Black rice food products

The overall mean acceptability for the appearance of black rice food products is presented as organoleptic score for appearance of Black rice food products in Figure 1

FIGURE – 1

Overall mean acceptability for Appearance of black rice food products



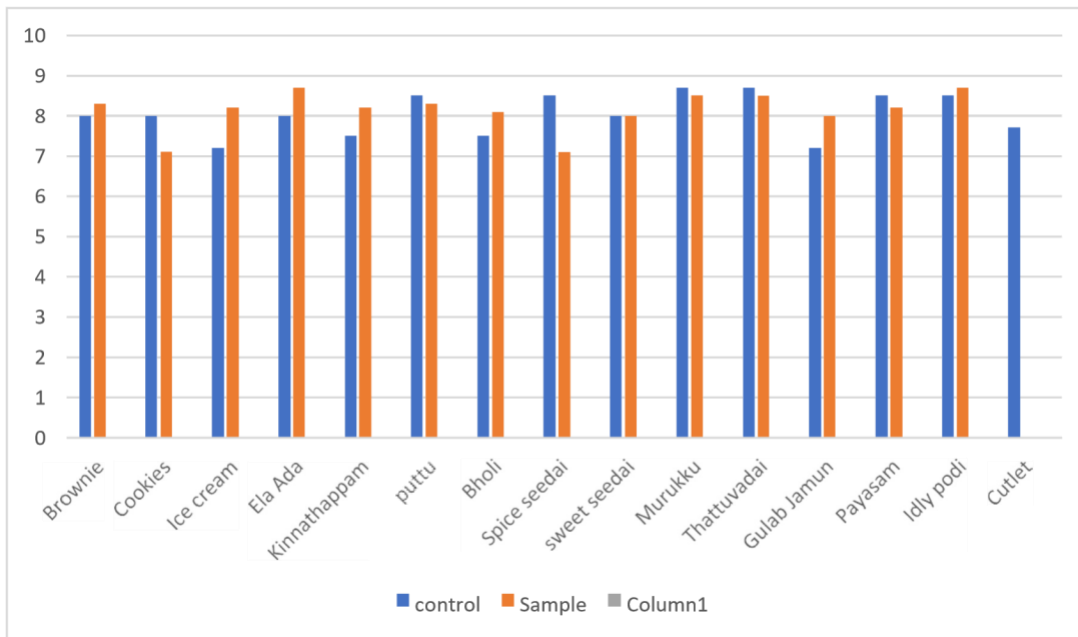
The above figure 1 depicts the bar diagram which compares the scores of controls and samples of all the 15 Black rice products for its appearance. From this bar diagram we can conclude that all the products prepared with black rice are highly acceptable for their appearance as there is only small difference seen in the scores comparing standard food products to formulated black rice food products.

Overall mean acceptability for Taste of Black rice food products

Overall mean acceptability for taste of Black rice food products is presented as organoleptic score for taste of black rice food products in Figure 2.

FIGURE 2

Overall mean acceptability for the taste of Black rice food products



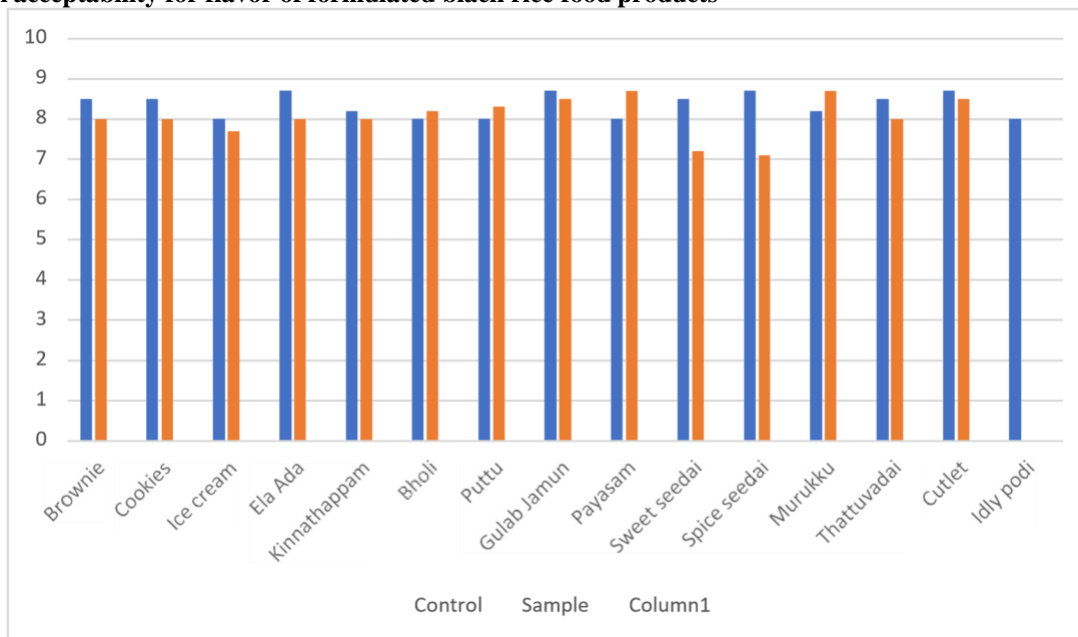
The above figure 2 depicts the bar diagram for the score of control and sample of all the black rice food products for their taste. When comparing the formulated black rice products to Control which is prepared in standard preparation method, The taste of all the products prepared are highly acceptable as there is only point difference in the scores comparing to standard sample.

Overall mean acceptability for Flavor of Black rice food products

Overall mean acceptability for flavor of Black rice food products is presented in Figure 3 as Organoleptic scores for the flavor of Black rice food products.

FIGURE 3

Overall mean acceptability for flavor of formulated black rice food products



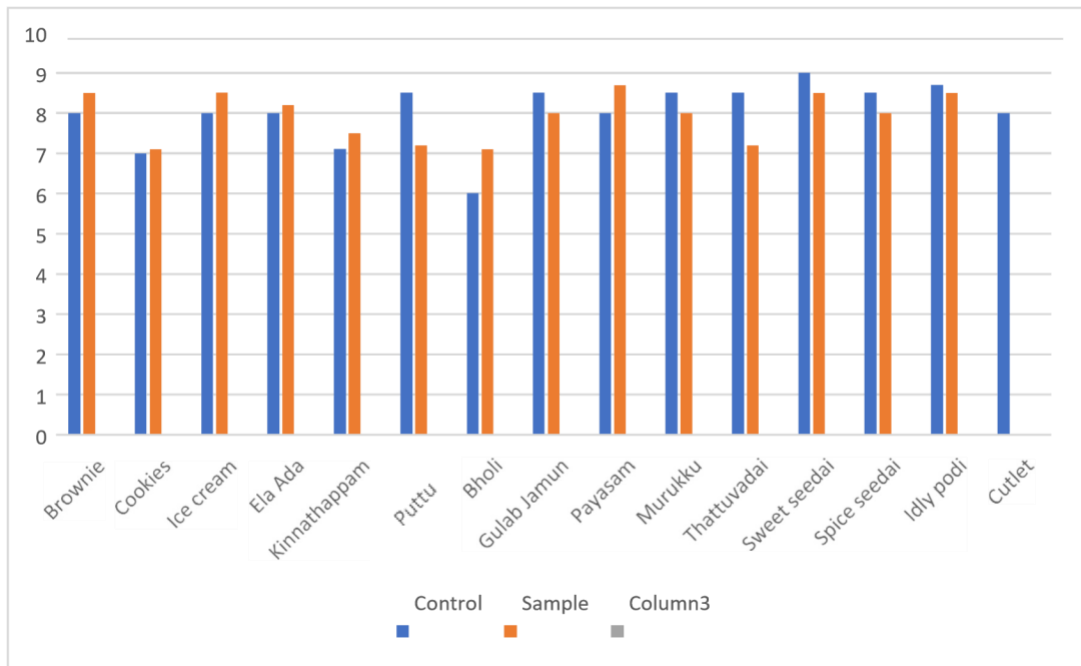
The above figure 3 depicts the bar diagram for the flavor of all the black rice food products prepared comparing to the control sample which is done in the standard procedure. From this bar diagram we can conclude that all the products prepared have acceptable flavor when comparing to the control sample which is a standard product. Whereas Black rice payasam has even better flavor than controlsample.

Overall mean acceptability for Texture of black rice food products

Overall mean acceptability for texture of black rice food products is presented as organoleptic score for texture of black rice food products in Figure 4.

FIGURE 4

Overall mean acceptability for texture of Black rice products



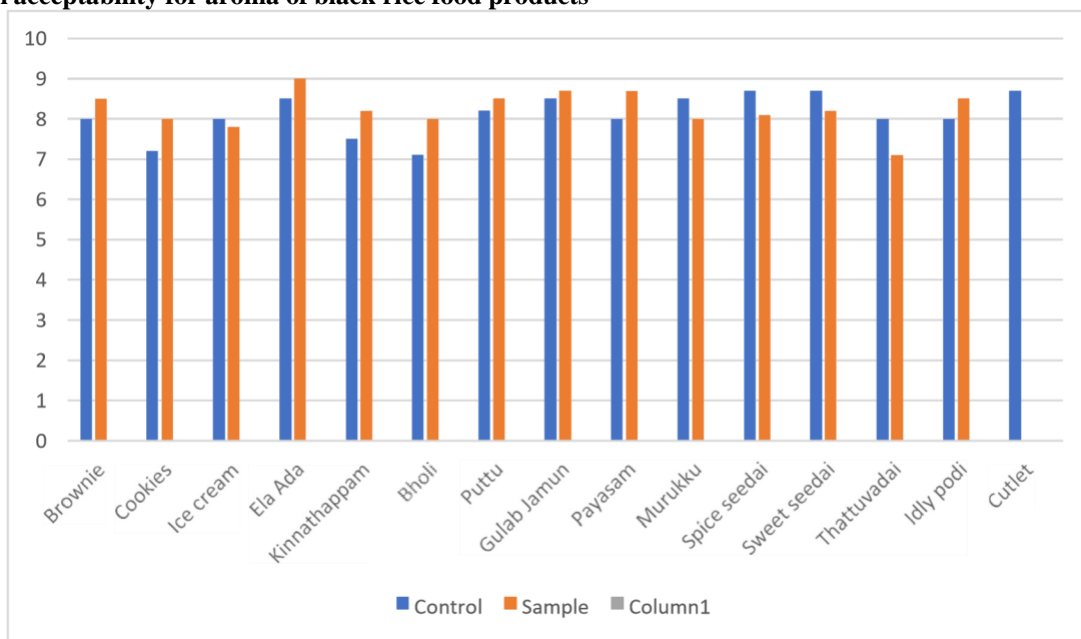
The above figure 4 depicts the overall mean acceptability for the texture of black rice food products as bar diagram which compares the texture of control samples to the texture of black rice products. According to the scores and bar diagram it is known that all the black rice products have good and acceptable texture except bholi and cookies when compared to other products, as their texture was a little bit harder than normal.

Overall mean acceptability for Aroma of black rice food products

Overall acceptability for aroma of black rice food products is presented as organoleptic score for aroma of formulated black rice products in Figure 5

FIGURE 5

Overall mean acceptability for aroma of black rice food products



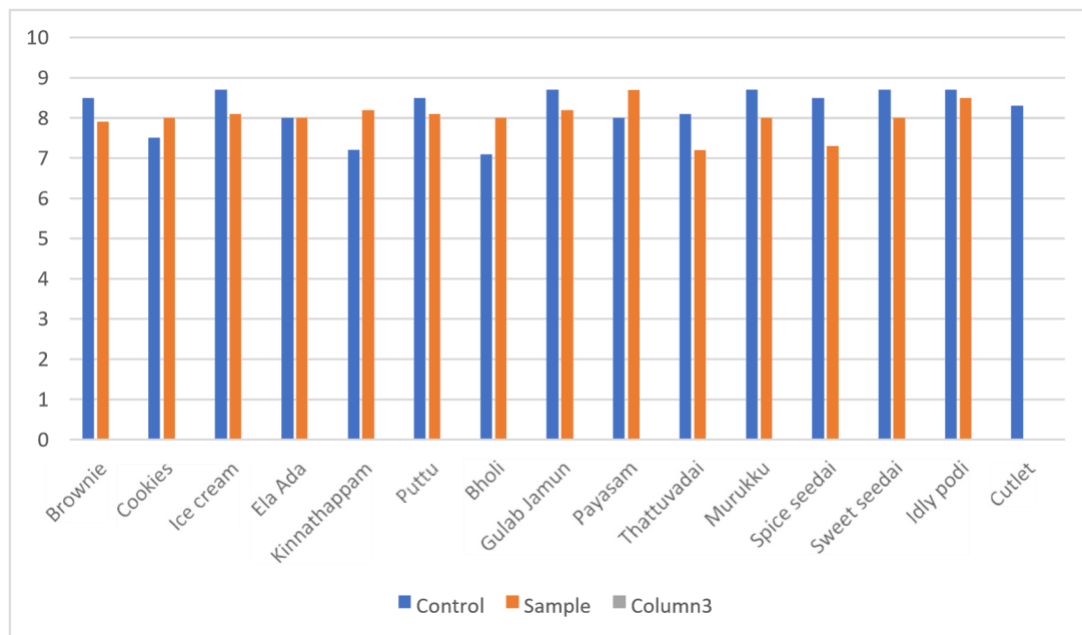
The above figure 5 depicts the overall acceptability for aroma of black rice food products by comparing it with the aroma of control sample which is prepared with standard procedure. From this bar diagram it is known that all the products prepared from black rice have acceptable aroma except black rice thattuvadai as a few pieces are burnt, because of the dark black color of black rice after frying in oil it is difficult to differentiate the well-cooked and uncooked pieces.

Overall acceptability of black rice food products

Overall acceptability of black rice food products is presented as organoleptic scores for overall acceptability of black rice food products in Figure 6.

FIGURE 6

Overall acceptability of black rice food products



The above figure 6 shows the overall acceptability of black rice food products when compared to control sample which is prepared by standard method of preparation. From the comparison in the bar diagram it is known that all the products prepared from black rice are highly acceptable overall for its Appearance, taste, texture, flavor, and aroma. Comparing to other products Black rice thattuvadai has low score for its overall acceptability as few pieces had burnt aroma.

IV SUMMARY AND CONCLUSION

Fifteen various food products were developed using 100% black rice under this study, which were replaced with 100% white rice. Few products which are made basically with white rice (Seedai, ElaAda, Kinnathappam, Murukku, Thattuvadai, payasam, Puttu) were replaced with black rice and it showed excellent outcome, even though the appearance of those products is in dark color and seemed not much appealing than black rice the taste, texture, aroma, and flavor of those products are highly acceptable and tasted same as products made from white rice.

Conclusion:

The products prepared from black rice were highly acceptable in all its characteristics like Appearance, taste, texture, aroma, and flavor hence it was concluded that all the food products done using black rice are safe, nutritious, tasty and healthy for consumption.

The black rice can also be incorporated in many other food products like chocolates, cakes, crackers, Breakfast bars etc. As Black rice is one of the rice varieties it possesses all the qualities of rice hence all the food products which are done by rice can also be done using black rice.

REFERENCES

1. Agarwal. A, Food and Agricultural Spectrum Journal, Vol. 2no. 03(2021), Black rice the New Black Gold of India, Published 2001-04-30.
2. Amirotul et al., 2019, Journal of Agricultural Food Chemistry, June 3, 2010.
3. Amrita Kumari, Ph. D. Scholar, Department of Genetics and plant Breeding, BCKV, Mohanpur, West Bengal- 741252.
4. Arshiya syeda, 2022
5. Bo et al., 2021, Journal of Biotechnology and Research, vol 7, Issue. 4.
6. Chung HS and Woo WS, August 2013
7. Dan Brennan MD, Black rice: Health Benefits, Nutrition and Uses, August 31, 2020.
8. Houz Z, 2010., Food Chemistry, Volume 287, 30 July 2019.
9. Jakobs S and Fridrich D, 2006
10. Kim and Jung Yun 2008
11. Kumar et al., Journal of Nutrition and Food sciences, 2020.
12. Ling, Wen Hua 2001
13. Mark Percivalnut, 1998
14. Mi et al., 2011, Food Research International, Vol 141, March 2021.
15. Min, sung – Won, Su – Noh Ryu and DongHyn Kim, 2010
16. Ming 2020., Food Chemistry, Volume 287, 30 July 2019
17. Nitin Kumar and Roshini Deepika Murali, Black rice: A Novel Ingredient in Food Processing, Journal of Nutrition and Food Science, Research paper – (2020) Volume 10, Issue 2.
18. Park, Young – Sam, Kim, Sun – Joong, Chang, Hyo – Ihl, 2008
19. Priya TS, Nelson AR, Ravichandran K, Antony U, 2019
20. Rassarin C et al., 2018, Journal of Biotechnology and Research, Vol 7, Issue 4.
21. Renata A, Soriano Glauca, Maria Pastore, 2012
22. Thanuja. B, Paramalavalli. R, Dept of Food Science and Nutrition, Periyar University, International Journal of Health Sciences and Research Vol.8; Issue: 2: February 2018.