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Utilization of Kodo Millet in Preparation of Fermented Food Products

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Abstract: ***This research was designed to produced kodo based fermented food products. Especially for protein energy malnutrition and diabetic patient which is fairly common worldwide in both children and adult. Protein energy malnutrition affects children the most because they have less protein intake and diabetes cause by high blood sugar. It is a condition that results from eating a diet in which nutrients are not enough or are too much such that it causes health problem. Many approaches to tackle the problem of protein energy malnutrition and control the blood sugar food based approach is considered the most sustainable one, despite being a long term strategy. Hence, exploring the possibility of value addition to traditional products is a better option to enhance the intake of micronutrients. Nutritional food products fill this need. Nutritional food products are supplements containing high energy. Nutritive product was developed for protein energy malnourished children and diabetes. The thesis was undertaken with two main objectives. The first objective was to optimize the level of ingredients using ANOVA. The second objective was to found the nutritive value from the ingredients namely kodo millet flour, rice flour, black gram dal, green gram dal.***

Kodo millet based product namely Idli, Dosa and Paniyaram rich source of nutrient antioxidant and rich in iron and folic acid which help prevent anaemia, diabetes, kidney disease. It is also beneficial for the cardiovascular disease like high blood pressure and high cholesterol levels.

Organoleptic evaluation of Idli, Dosa and Paniyaram in relation to sensory attributes which indicates that Idli T_2 (Kodo millet flour + Rice flour + black gram dal) had the highest score and T_1 of Dosa (Kodo millet flour + Rice flour + Black gram dal + Green gram dal) showed that highest score and T_2 of Paniyaram (Kodo millet flour + Rice flour + black gram dal + green gram dal) had the highest score.

The nutritional composition of the best product T2 increased with the incorporation of prepared mix batter in Idli the protein contain was found to be 12.037/100g, Fat contained was found be 1.2448/100g, Fiber contain to be 4.803/100g, Carbohydrate contain to be 62.088/100g, Energy contain to be 332.01/100g, Calcium contain to be 57.849/100g, Iron contain to be 2.437/100g. On applying t- test it was found Protein, fat, Fiber, Calcium content increased. The nutritive composition of the dosa (T_1) increase the incorporation of prepared mix batter, the protein contain was found to be 16.606/100g, Fat contained was found be 1.158/100g, Fiber contain to be 2.44/100g, Carbohydrate contain to be 88.802/100g, Energy contain to be 309/100g , Calcium contain to be 52.3/100g, Iron contain to be 3.339/100g . On applying t- test it was found Protein, carbohydrate, Fiber, Calcium, Iron content increased. The nutritive composition of the Paniyaram (T_2) increase the incorporation of prepared mix batter, the protein contain was found to be 16.426 /100g, Fat contained was found be 1.43/100g , Fiber contain to be 5.681/100g, Carbohydrate contain to be 79.917/100g, Energy contain to be 304.01/100g , Calcium contain to be 45.61/100g, Iron contain to be 2.213/100g . On applying t- test it was found Protein, fat, Fiber, Calcium content increased Idli per 100g T0 (10.6 Rs.), T1 (12.11Rs.), T2 (13.46 Rs.) and T3 (14.71 Rs.) The cost of the Dosa per 100g T0 (10.6Rs.), T1 (12.11 Rs.), T2 (13.4 Rs.) and T3 (14.71 Rs.) and Paniyaram per 100g T0 (10.6 Rs.), T1 (13 Rs.), T2 (14.6 Rs.) and T3 (20.8 Rs)

Kodo based fermented products should be recommended for diabetes, protein energy and malnutrition and all age groups as it helps to boost immunity and also improves physical growth and good memory.

Keywords: Idli, Dosa, Paniyaram, Organoleptic, Nutritional Composition, Cost Calculation

I. INTRODUCTION

Kodo millet have been utilized for human food from prehistoric times. It is consumed in India Africa and Southern Russia. Kodo millet is a nutrient grain and a good substitute to the rice or wheat. It is good source of protein, vitamins, and micro-nutrients. It is excellent source of fiber. Kodo millet is nourishing food substances and good substitute to rice. It reduces then fasting blood glucose level and promotes significant increase in serum insulin level. Anti- diabetic compounds in kodo are quercetin, ferulic acid and syringic acid. Regular use of kodo millet is recommended for diabetic patients.

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Kodo millet grain consists of polyphenols and antioxidant, kodo is high in fiber and prevents gain in weight. It is rich in nutrient wish is also good for children. It also helps to prevent rise in cholesterol and triglyceride levels and is a functional food to manage weight and promote weight loss. Kodo millet is beneficial for women suffering from cardiovascular disease, high blood pressure and high cholesterol levels; it is low in fat content high in fiber content and makes us feel fuller after consuming it in less quantity it therefore avoids overeating and lessens the weight, thereby controls obesity.

Kodo millet is rich in B vitamin, especially niacin, B6 and folic acid, as well as minirals such as calcium, iron, potassium, magnesium and zinc. It is easy to digest. Regular consumption of kodo millets helps to lower the triglycerides and C- reactive protein, thus it lower the bad cholesterol and ideal for heart. Kodo millet is rich in dietary fiber. It releases the glucose or energy slowly, over a longer period of time and helps to control sugar. It is good source of vitamin and it's easy to digest in the body and high amount of lecithin give strength to the nerves system. It can control the haemorrhages and general disability.

Kodo millet contains phytate which help to reduction of cancer. This millet cures fever, cold, malaria, and dengue. It is used to prevent the bone cancer and is used to regenerate cell in the bone marrow. It is good for the thyroid patient. It is also good for the skin allergy and getting cured. It repairs the damage cells. Kodo millet is an antioxidant that can help in reducing the free radicals. It is use for traditional as well as novel foods.

Fermented food are food substrates that are invaded by edible microorganism, whose enzymes, particularly amylase, proteases, lipases hydrolyzes the polysaccharides, proteins and lipid to non-toxic products with flavours, aroma and textures pleasant and attractive to the human consumer. Fermentation of food is a complex mixture of carbohydrate, protein, fats etc. Fermented product enhances the quality, consistency, functionality, safety, shelf life and easy to digest.

Fermentation improves the shelf life of the product and includes preservation of pathogenic combination. It contains living microorganisms which provide health benefits. Fermentation can reduce anti-nutrient such as phytic acid bound to minirals in grain and increase the bioavailability of certain nutrient through enzymes activity. It can enhance nutrient availability and anti-oxidant activity.

Fermentation produces texture changes, increases the nutritive value and this food are easily digestible and possess high degree of acceptability. Fermentation processes appear to have a significant effect on elimination or reduction of anti-nutrients (phytic acid enzyme inhibitors), the flatulence problem and appreciable reduction in oligosaccharides. It improves the bioavailability of minerals like zinc and iron fermentation is referred as probity, which has been shown to have health benefits to the human body. Fermentation is a primary means of producing ATP by the degradation of organic nutrients an aerobically in presents of suitable microorganisms these health enhancing microorganisms bring about fermentation, resulting in production of lactic acid and hence commonly referred as Lactic acid bacteria (LAB).

Traditional fermented foods from most common types of cereals (such as rice, wheat, corn or sorghum) are well known in various parts of the world. Some are utilized as colorants, spices, beverage and breakfast or light meal foods like idli, dosa paniyaram etc. Fermented foods are better than normal cooked food verities in term of nutrition, amenability for digestion. Fermentation products improve the food safety, gastrointestinal and overall health. The preparation of value added food product with incorporation fermentation kodo millet will be low cost so that these are affordable for people. These food products can fight against the diabetes and preventing from many life style diseases.

II. MATERIALS AND METHODS

The present study entitled **"Utilization of Kodo Millet in preparation of fermented food products"** was conducted in the Nutrition Research Laboratory, Department of Food Nutrition and Public Health, Ethelind Collage of Home Science, Sam Higginbottom university of Agriculture, Technology & Sciences, Allahabad. The details of materials, experiment, procedures to be followed and techniques to be adopted during the course of present investigation were elaborated in this chapter under the following heads.

A. Precurment Of Raw Materials

Kodo millet, Black gram dal, Fenugreek seed, Rice flour, Onions, Green onion, Green chiles, Green peas, Dehydrated beetroot, Carrot, Oil and Cumin seeds was purchased from local market of Naini area.

B. Site Of Experiment

The present investigation was carried out in the Nutrition Research Laboratory of the Department of Food Nutrition and Public Health, Sam Higginbottom university of Agriculture, Technology & Sciences, Allahabad.

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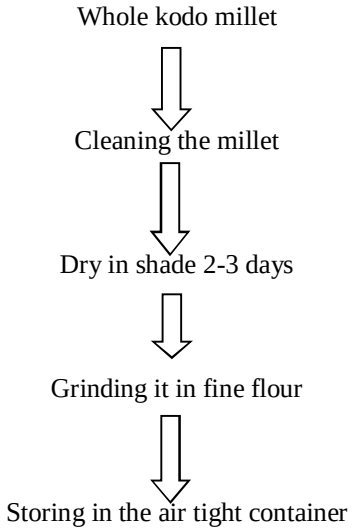
C. Processing Of Kodo Millet Flour



(Source: Poornima's Cook book, 2016)

D. Formulation Of Products

Three fermented food products namely – Idli, Paniyaram and Dosa will be prepared using kodo millet. The products will prepared by using standard recipe.

III. TREATMENT AND REPLICATION OF PRODUCTS

Preparation of Idli with incorporation of Kodo millet flour

Ingredient	T0	T1	T2	T3	Replication
Rice Flour	73g	49g	34g	19g	3
Back gram dal	25g	25g	25g	25g	3
Fenugreek seed	2g	2g	2g	2g	3
Kodo millet flour	-	15g	30g	45g	3
Dehydrated beetroot	-	3g	3g	3g	3
Carrot	-	3g	3g	3g	3
Green onions	-	2g	2g	2g	3
Green chilli	-	1g	1g	1g	3

Preparation of Dosa with incorporation of Kodo millet flour

Ingredient	T0	T1	T2	T3	Replication
Rice flour	73g	45g	30g	15g	3
Kodo millet flour	-	15g	30g	45g	3
Black gram dal	25g	20g	15g	10g	3
Green gram dal	-	5g	10g	15g	3
Fenugreek seed	2g	2g	2g	2g	3
Green peas	-	8g	8g	8g	3
Carrot	-	5g	5g	5g	3

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Preparation of Paniyaram with incorporation of Kodo millet flour

Ingredient	T0	T1	T2	T3	Replication
Rice flour	73g	49g	29g	9g	3
Kodo millet flour	-	20g	40g	60g	3
Black gram dal	25g	20g	15g	10g	3
Green gram dal	-	5g	10g	15g	3
Fenugreek seed	2g	2g	2g	2g	3
Onion green	-	2g	2g	2g	3
Green chillies	-	1g	1g	1g	3
Cumin seed	-	1g	1g	1g	3

IV. PREPRATION OF PRODUCTS (IDLI, DOS, PANIYARAM)

A. Method Kodo Millet Idli

In a bowl, add black gram dal, fenugreek seed, rice flour, kodo millet flour and wash them. Soak them in fresh water for 4 hours. Transfer ingredients to the grinder. Pour a little amount of water and add salt. Grind to a fine thick batter. Transfer the batter into a large vessel and keep aside for overnight. Pour ladleful batter and add carrot dehydrated beetroot, green onion and green chilli in idli and steam for 10 minutes. Prick a fort to check if the idli is prepared. Idli on serving plates and serve with sambar and coconut chutney.

B. Method Kodo Millet DOSA

Wash Kodo millet, raw rice, black gram dal, green gram dal and fenugreek seed seeds well. Soak in enough water for 4-6 hours. Drain the water and grind to a very smooth better. Use as less water as needed while grinding. Add salt and mix well. Set the batter for fermentation for 12 hours. Once the better is well fermented mix well and takes the required amount of batter in a separate vessel. Add about water and bring the batter to spreadable consistency and add carrot, green peas. Heat a tava, once the tava is hot reduces the flame and pour a ladle full of batter. Spread well to make thin dosa. Increase the flame and cook the dosa well from both sides. Add oil towards the edges while cooking. Repeat the same to make more dosa. Serve millet dosa hot with sambar or chutney.

C. Method Kodo Millet PANIYARAM

First soak black gram dal, Kodo millet, rice flour, green gram dal and fenugreek seeds for 4 hours. Now blend into fine paste, mix salt and keep aside for fermentation. It will take 8 hours at least. Now mix all chilli and carrots. Mix it well. Batter should be semi thick in consistency and add green onion green chilli and cumin seeds. Heat paniyaram pan pour the mixture apply oil lower the heat cover and cook one side after 5 minute flip them and cook both sides. Serve hot with coconut chutney.

D. Sensory Evaluation

Sensory evaluation of the food products for their acceptability was done by a panel of 5 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, Body and Texture, Taste and Flavors and Overall Acceptability **(Srilakshmi, 2007).**

E. Determination Of Cost

Cost of the prepared products was calculated taking into account the cost of individual raw ingredients used in the preparation of the food products at the prevailing market price.

F. Statistical Analysis

Analysis of variance technique (ANOVA) and Critical difference were used to analyses the data (Gupta and Karoo, 2002).

V. RESULT AND DISCUSSION OF ORGENOLEPTIC EVALUATION OF IDLI, DOSA, PANIYARAM

Three products were prepared ‘Idli’, ‘Dosa’ and ‘Paniyaram’ by the incorporation of kodo millet flour, rice flour, black gram dal and green gram dal. The basic recipe of Idli, Dosa and Paniyaram with the incorporation of kodo millet flour, rice flour and black gram dal and green gram as a control served. It was found in the treatment – Idli T_2 (rice flour 34% + kodo millet flour 30% + black gram dal 25%), T_1 Dosa (rice flour 45% + kodo millet flour 15% + black gram dal 20%+ green gram 5%), T_2 Paniyaram (rice flour 29% + kodo millet 40% + black gram dal +15% + green gram dal 5%)**.**

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The organoleptic evaluation of products with regard to attributes of colour, body and texture, flavour, taste and overall acceptability were done using a nine point hedonic scale. The findings of the entire study are reported as follows: The observations were recorded, tabulated and results were statistically analyzed by analysis of variance technique, critical difference and t-test.

A. Nutrition Composition Of Developed Products

The nutritive composition of the Idli (T_2) increase the incorporation of prepared mix batter, the protein contain was found to be 12.037/100g, Fat contained was found be 1.2448/100g , Fiber contain to be 4.803/100g, Carbohydrate contain to be 62.088/100g, Energy contain to be 332.01/100g , Calcium contain to be 57.849/100g, Iron contain to be 2.437/100g . On applying t- test it was found Protein, fat, Fiber, Calcium content increased. The nutritive composition of the dosa(T_1) increase the incorporation of prepared mix batter, the protein contain was found to be 16.606/100g, Fat contained was found be 1.158/100g , Fiber contain to be 2.44/100g, Carbohydrate contain to be 88.802/100g, Energy contain to be 309/100g , Calcium contain to be52.3/100g, Iron contain to be 3.339/100g . On applying t- test it was found Protein, carbohydrate, Fiber, Calcium, Iron content increased. The nutritive composition of the Paniyaram (T_2) increase the incorporation of prepared mix batter, the protein contain was found to be 16.426 /100g, Fat contained was found be 1.43/100g , Fiber contain to be 5.681/100g, Carbohydrate contain to be 79.917/100g, Energy contain to be 304.01/100g , Calcium contain to be 45.61/100g, Iron contain to be 2.213/100g . On applying t- test it was found Protein, fat, Fiber, Calcium content increased.

The Average nutritional composition of control and the best treatment samples of “Idli” per 100g

Nutrient	(T0)	(T2)	Difference (T0-T2)=D)	T (calculated)	T(tabulated) Value at 5%	Result
Protein(g)	11.999	12.037	0.038	1.534	2.776	NS
Fat(g)	1.196	1.244	0.048	1.245	2.776	NS
Crude fiber(g)	0.807	4.803	3.996	14.283	3.182	S
Carbohydrates(g)	71.732	62.088	9.644	49.937	4.302	S
Energy(kcal)	345.99	332.01	23.98	44.986	4.302	S
Calcium(mg)	49	57.849	48.42	198.339	2.776	S
Iron(mg)	3.416	2.437	0.97	52.983	2.776	S

The Average nutritional composition of control and the best treatment samples of “Dosa” per 100g.

Nutrient	(T0)	(T1)	Difference (T0-T1)=D)	T (calculated)	T(tabulated) Value at 5%	Result
Protein(g)	11.999	16.606	4.607	8.873	4.302	S
Fat(g)	1.196	1.158	0.038	1.147	2.776	NS
Crude fiber(g)	0.807	2.444	1.637	12.144	4.302	S
Carbohydrates(g)	71.773	88.802	17.029	95.972	4.302	S
Energy(kcal)	385.81	309.79	76.02	2473.87	2.776	S
Calcium(mg)	43.6	52.3	8.7	21.07	3.182	S
Iron(mg)	1.688	3.339	1.651	53.161	2.776	S

The Average nutritional composition of control and the best treatment samples of “Paniyaram” per 100g.

Nutrient	(T0)	(T2)	Difference (T2-T0)=D)	T(calculated)	T(tabulated) Value at 5%	Result
Protein(g)	11.841	16.426	4.585	171.625	2.776	S
Fat(g)	1.196	1.43	0.234	7.348	2.776	S
Crude fiber(g)	0.807	5.681	4.874	38.783	4.302	S
Carbohydrates(g)	71.773	79.91	8.137	258.042	3.182	S
Energy(kcal)	345.99	304.54	41.45	422.597	3.182	S
Calcium(mg)	49	45.61	3.39	1083.75	3.182	S
Iron(mg)	3.416	2.213	1.203	45.125	2.776	S

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B. Cost of the Developed Ready to Eat Snacks (Rs/Kg)

Cost of the prepared products namely Idli

Ingredient (g)	Actual Rate/Kg (Rs)	Treatment							
		T0		T1		T2		T3	
		Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)
Rice flour	105	73	7	49	5	34	3.5	19	1.9
Black gram dal	135	25	3	25	3	25	3	25	3
Fenugreek seed	150	2	0.3	2	0.3	2	0.3	2	0.3
Kodo millet flour	200	-	-	15	3	30	4.5	45	6.7
Dehydrated Beetroot	30	-	-	3	0.09	3	0.09	3	0.09
Carrot	50	-	-	3	0.15	3	0.15	3	0.15
Green onion	50	-	-	2	0.1	2	0.1	2	0.1
Green chilli	30	-	-	1	0.03	1	0.03	1	0.03
Total	830	100	10.6	100	12.11	100	13.4	100	14.71

Cost of the prepared products namely Dosa

Ingredient (g)	Actual Rate/Kg (Rs)	Treatment							
		T0		T1		T2		T3	
		Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)
Rice flour	105	73	7	45	4.7	30	3.15	15	1.5
Kodo millet flour	200	-	-	15	3	30	6	45	9
Black gram dal	135	25	3.3	20	2.7	15	2.0	10	1.3
Fenugreek	150	2	0.3	2	0.3	2	0.3	2	0.3
Green peas	70	-	-	8	0.56	8	0.56	8	0.56
Carrot	50	-	-	5	0.25	5	0.25	5	0.25
Green gram dal	120	-	-	5	0.6	10	1.2	15	1.8
Total	830	100	10.6	100	12.11	100	13.4	100	14.71

Cost of the prepared products namely Paniyaram

Ingredient (g)	Actual Rate/Kg (Rs)	Treatment							
		T0		T1		T2		T3	
		Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)	Quantity (g)	Cost (Rs)
Rice flour	105	73	7	49	5.1	29	3.0	9	0.9
Kodo millet	200	-	-	20	4	40	8	60	16
Black gram dal	135	25	3.3	20	2.7	15	2.0	10	1.3
Green gram dal	120	-	-	5	0.6	10	1.2	15	1.8
Fenugreek seed	150	2	-	2	0.3	2	0.3	2	0.3
Green onion	50	-	-	2	0.1	2	0.1	2	0.1
Green chilli	30	-	-	1	0.03	1	0.03	1	0.03
Cumin seed	165	-	-	1	0.16	1	0.16	1	0.16
TOTAL	955	100	10.6	100	13	100	14.6	100	20.8

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VI. CONCLUSION

On the basis of findings, it is concluded that kodo millet was found to be rich in Iron, calcium, fiber, protein, carbohydrate and anti-oxidant content and it was successfully incorporated in preparation of the products like Idli, Dosa and Paniyaram. Sensory evaluation showed that the treatment T_2 of Idli (kodo millet flour+ rice flour+ black gram dal) was the most acceptable and the treatment T_1 of Dosa (kodo millet flour + rice flour + black gram dal + green gram dal) was the most acceptable and paniyaram showed that the treatment T2 (kodo millet flour + rice flour + green gram dal + black gram dal) was found most highly acceptable. The content of iron, calcium, protein, fat, fiber, carbohydrate, potassium, and zinc increased significantly in Idli, Dosa, and Paniyaram. The antioxidant content such as total polyphenols and anti-radical scavenging activity were also increased significantly in Idli, Dosa, and Paniyaram. The incorporation levels of kodo millet flour increased the cost but it is comparatively cheaper than the control even through it was marginal.

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Plate 1: Idli Prepared By Kodo Millet Incorporation Of Black Gram Dal And Rice Flour

Plate 2: Dosa prepared by kodo millet incorporation of black gram dal, green gram dal and rice flour

Plate 3: Paniyaram prepared by kodo millet incorporation of black gram dal, green gram dal and rice flour

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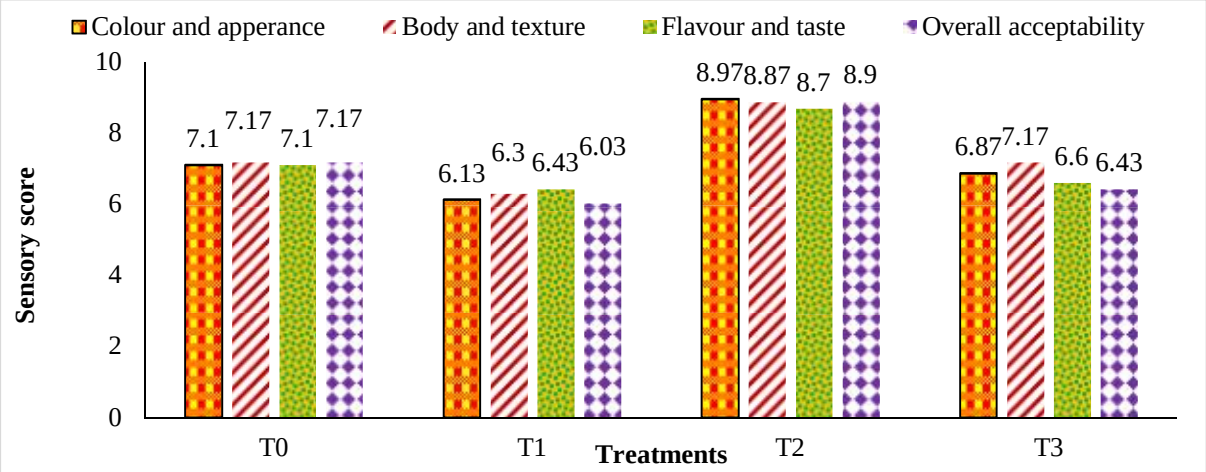
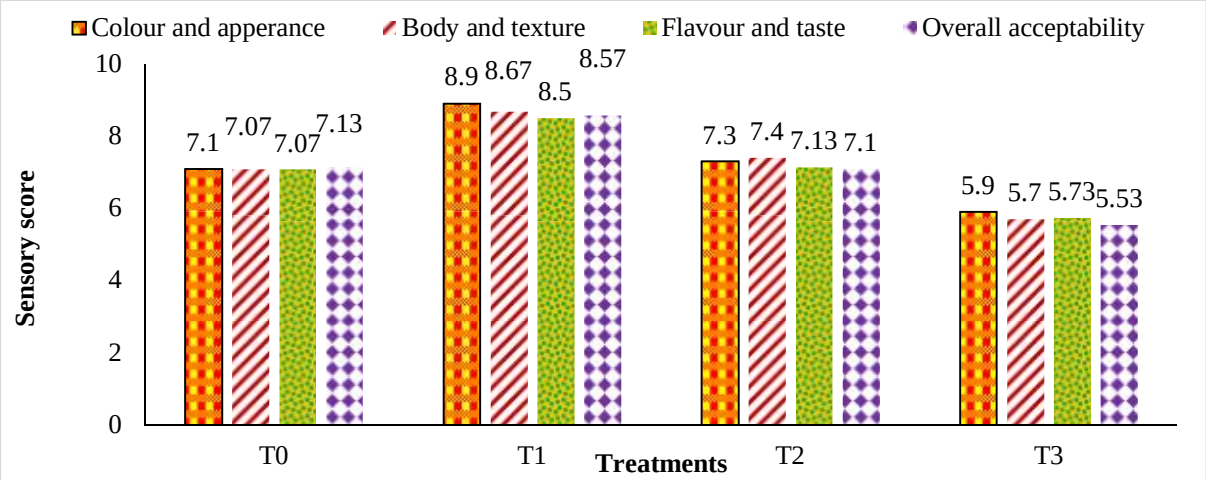
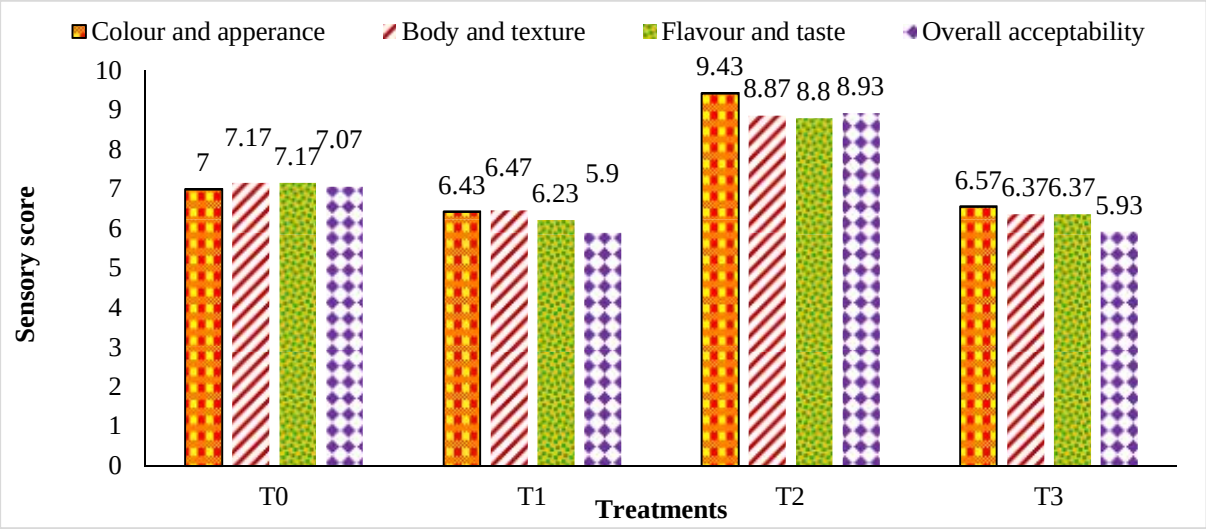
Graph 1: Organoleptic evaluation of idli



Graph 2: Organoleptic evaluation of dosa



Graph 3: Organoleptic evaluation of paniyaram



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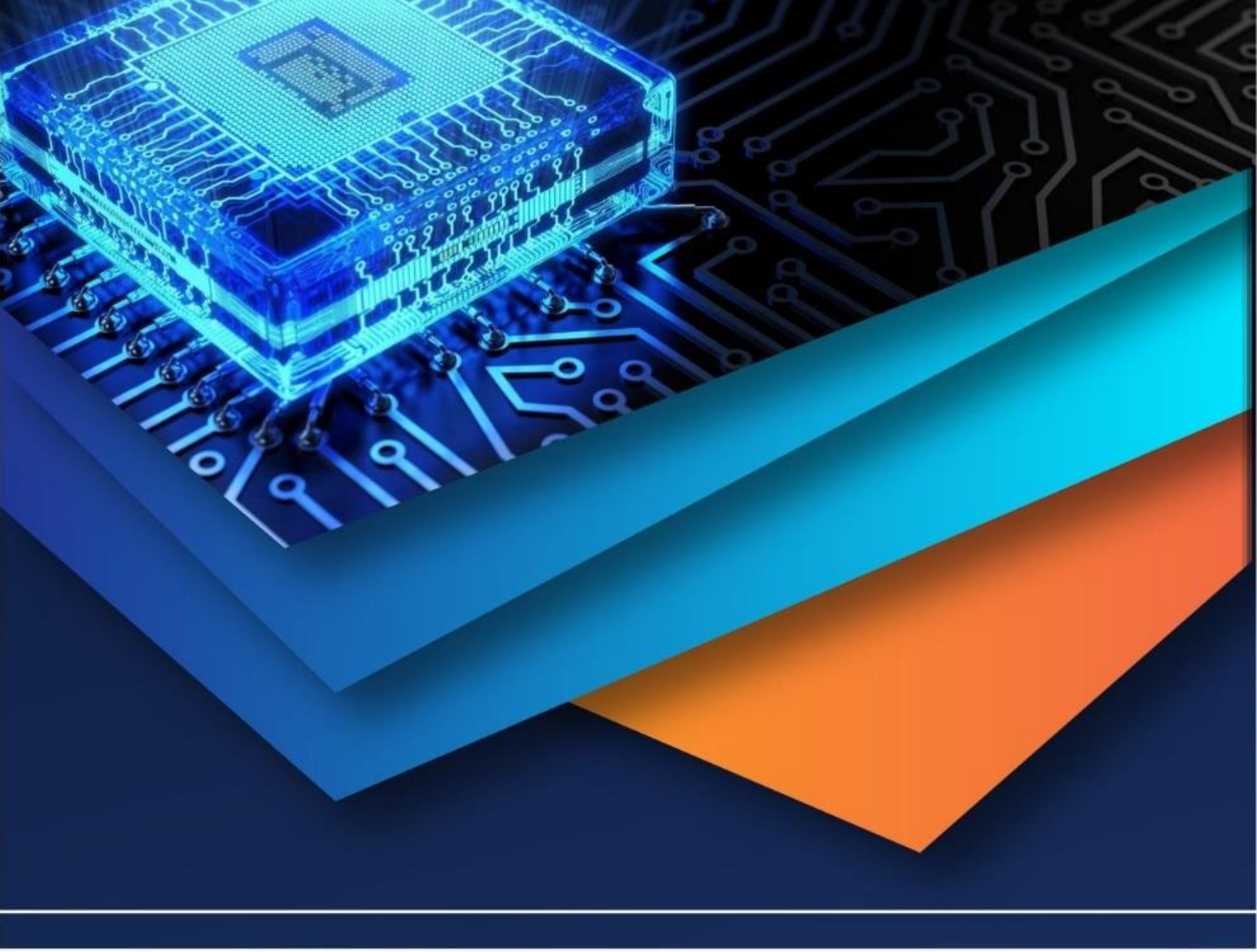

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