Phytochemical Screening, Physical Parameters And Nutritional Composition of PARPALUM SCROBICULATION Enriched Chocolate

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Abstract- *Millets are a group of small, nutritious grains that have been a staple food for thousands of years, particularly in Asia and Africa.Kodo millet (Paspalum scrobiculatum) is an incredibly nutritious grain that offers a wide range of health benefits. Rich in essential nutrients, it is an excellent source of complex carbohydrates, dietary fibre, and high-quality protein .They belong to the grass family and are grown in various forms, including pearl millet, finger millet, and foxtail millet. The growing interest in functional foods has fueled the demand for chocolate that incorporates healthy ingredients like millet. Chocolate and millet, two foods with rich histories and unique benefits, are now being combined to create innovative and healthy snack options. When combined with chocolate, a universally loved treat, millet offers a unique opportunity to make a more health-conscious and sustainable chocolate product .*

Combining these two ingredients creates a product that not only satisfies sweet cravings but also offers functional health benefits. In recent chocolate-millet bars and snacks are becoming popular for their ability to provide a steady energy release and also offers environmental benefits.Hence, the current research aimed in the formulation and standardization of kodo millet chocolate with the numerous health benefits of millet, creating a snack that not only satisfies the taste buds but also contributes to a healthier, more sustainable lifestyle.

Keywords- Kodomillet, Functional foods, Gluten-free, Antioxidants, Food Security.

I. INTRODUCTION

Kodo millet *(Paspalum scrobiculatum*) is an incredibly nutritious grain that offers a wide range of health benefits. Rich in essential nutrients, it is an excellent source of complex carbohydrates, dietary fibre, and high-quality protein. The fibre content in kodo millet aids in improving digestion and helps regulate blood sugar levels, making it beneficial for people with diabetes. Kodo millet is also an excellent source of vital minerals such as iron, calcium, magnesium, and phosphorus. Iron plays a key role in preventing iron-deficiency anaemia by supporting healthy red blood cell production, while calcium is important for maintaining strong bones and teeth. Magnesium, another mineral present in substantial amounts, is essential for muscle function, nerve transmission, and energy production. Additionally, the high levels of antioxidants in kodo millet, including polyphenols and flavonoids, help fight oxidative stress in the body, potentially lowering the risk of chronic diseases such as cardiovascular disease and cancer.

Hence, the present study focused on the innovative combination that leverages the nutritional richness of millets along with chocolate offering a healthy value product, known for its excellent storage stability.

II. MATERIALS AND METHODS

The clean, dry, free from debris or contaminant uniform kodomillet grains that are light brown in colour were selected for the study.The selected grains possess a mild,neutral ,aroma and free from rancid and ensures better quality. Kodo millet is highly regarded for its cooking versatility and nutritional benefits.

i) PHYSICAL PARAMETERS

The muffins were weighed after cooling at room temperature for an hour, using weighing balance and the reading (g) was recorded. The height (cm) of muffins was measured using ruler. Three measurements were taken from different sides of muffins. The average of the three points was recorded.

ii)DEVELOPMENT OF STANDRARD AND VALUE ADDED PRODUCT

PREPARATION OF DARK CHOCOLATE

Ingredients (for about 100g of dark chocolate):

Cocoa Beans powder – 70g
Cocoa Butter – 30g
Sugar – 20g
Vanilla Extract – 1 tsp

Procedure:

In a double boiler, gently melt the cocoa butter until it turns into a liquid.Slowly add the cocoa powder to the melted cocoa butter while stirring gently helps them to blend together. Add sugar to the mixture. Stir continuously until the sugar is fully dissolved and the mixture reaches smooth consistency .Then add 1 tsp vanilla extract to enhance the flavor.Pour the tempered chocolate into molds or a parchment-lined tray.Let the chocolate set at room temperature or refrigerate for about 30 minutes until it solidifies. Once set, remove the chocolate from the molds and store in an airtight container at a dry place.

PREPARATION OF WHITE CHOCOLATE

Ingredients :

Cocoa Butter – 30g
Powdered Sugar – 20g
Milk Powder – 100g
Vanilla Extract – 1 tsp

Procedure:

- In a double boiler, gently melt the cocoa butter until it is completely liquid.
- Once the cocoa butter has melted, add the milk powder.
- Stir thoroughly to ensure the milk powder dissolves completely in the cocoa butter.
- Slowly add the powdered sugar to the mixture.
- Stir in the vanilla extract for flavor, and ifdesired.
- Stir everything together until the mixture is smooth and fully combined.
- Pour the tempered white chocolate into molds or a parchment-lined tray .
- Let the chocolate set at room temperature or refrigerate for about 30 minutes until solidified. Once set, remove the chocolate from the molds,Store it in an airtight container at a cool, dry place.

PREPARATION OF *Paspalum scrobiculatum* enrichedDARK CHOCOLATE

Ingredients :

Cocoa Beans powder – 70g
Cocoa Butter – 30g
Sugar – 20g
Kodo millet -25/40g
Vanilla Extract – 1 tsp

Procedure:

- To prepare millet, begin by cleaning the grains thoroughly to remove any dirt or debris.
- Once cleaned, soak the millet in water for about 4-6 hours to help soften the grains and reduce roasting time.
- After soaking, drain the millet well and spread it out on a clean cloth or tray to dry.
- Allow it to air-dry completely, ensuring no moisture remains, which can affect the roasting process.
- Once the millet is dry, heat a pan or skillet over medium heat.Add the millet and roast it in small batches, stirring frequently to ensure even roasting. Continue to roast until the millet turns golden brown and emits a nutty aroma.
- Once roasted, let it cool completely before storing. This process enhances the flavor and texture of the millet, making it perfect for various dishes.
- Now,In a double boiler, gently melt the Dark chocolate and add the prepared millet to the melted chocolate and mix it will.

Pour the millet chocolate mix intomolds or a parchment-lined tray.

- Let the chocolate set at room temperature or refrigerate for about 30 minutes until solidified. Once set, remove the chocolate from the molds. Store it in an airtight container at a cool, dry place.

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iii) PHYTOCHEMICAL SCREENING

Preparation of the sample 5g of the sample was taken in a beaker and 200ml of distilled water was added. The mixture was heated in a hot water bath for 10minutes with continuous stirring . It was cooled and filtered through a filter paper and the filtrate was used for the phytochemical analyse.

TEST FOR PROTEINS

To test for proteins, 2 mL of the sample was mixed with a few drops of concentrated nitric acid. The mixture was heated gently, and the development of a yellow coloration indicated the presence of proteins. On adding a few drops of an alkaline solution (e.g., sodium hydroxide or ammonium hydroxide), the yellow colour intensified to orange, confirming the presence of aromatic amino acids in the protein structure.

TEST FOR CARBOHYDRATES

To test for carbohydrates, particularly polysaccharides like starch, 2 mL of the sample was mixed with a few drops of iodine solution. The formation of a blue-black coloration indicated the presence of starch or related carbohydrates. This color change results from the interaction of iodine molecules with the helical structure of starch.

TEST FOR SAPONINS

The Saponins test was performed by adding 2 mL of the sample to 2 mL of distilled water in a graduated cylinder. The mixture was then shaken vigorously for a few minutes to facilitate the formation of foam. The stable foam observed on the surface of the liquid confirmed the presence of saponins. This froth formation is characteristic of the surfactant-like properties of saponins.

TEST FOR FLAVONOIDS

To determine the presence of Flavonoids, 2 mL of the sample was transferred into a clean test tube, and 1 mL of 2N sodium hydroxide solution was carefully added. The reaction mixture was observed for the development of a yellow coloration, which is indicative of the presence of Flavanoid compounds. This color change occurs due to the interaction of Flavonoids with the alkaline medium.

TEST FOR ALKALOIDS

To determine the presence of **alkaloids**, 2 mL of the sample extract was transferred into a clean test tube. Then, 1 mL of **Mayer's reagent (potassium mercuric iodide solution)** was carefully added. The reaction mixture was observed for the formation of a **cream-colored precipitate**, which indicates the presence of alkaloid compounds. This precipitation occurs due to the interaction of alkaloids with Mayer's reagent, forming insoluble complexes.

iv) SENSORY EVALUTION OF VALUE-ADDED PRODUCT

Sensory evaluation is the common experimental structure evaluating the dishes for their acceptance. This evaluation helps in the new product or recipe development or formulation of traditional dishes with modern concepts.The prepared kodo millet chocolate and served to the panel of 30 semi trained panelists and evaluated the sensory properties namely appearance, taste, texture, flavour.

III. RESULTS AND DISCUSSION

NUTRITIVE VALUE FOR THE CHOCOLATE

The following table predicts the micronutrient values of the standard product.

i)MACRONUTRIENTFORDARKCHOCOLATE

TABLE-I
MACRONUTRIENTCOMPOSITIONOFSTANDARD(X1)

INGREDIENTS	AMOUNT (g)	ENERGY (Kcal)	PROTEIN (g)	CHO (g)	FIBER (g)	FAT (g)
cocoa beans powder	70g	159.6	13.7	40.5	25.9	9.6
cocoabutter,	30g	265.2	-	-	-	30
Sugar	20g	77.4	-	20	-	-
vanillaextract	1tsp(5ml)	12	-	1.3	-	-
Total		**514.2kacl**	**13.7g**	**61.8g**	**25.9g**	**39.6g**

TABLE -II
MACRONUTRIENTCOMPOSITIONOFVARIATION-I(X2)

INGREDIENTS	AMOUNT (g)	ENERGY (Kcal)	PROTEIN (g)	CHO (g)	FIBER (g)	FAT (g)
cocoa beans powder	70g	159.6	13.7	40.5	25.9	9.6
cocoabutter,	30g	265.2	-	-	-	30
Kodomillet	25g	87.75	2.75	17	2.1	0.9
Sugar	20g	77.4	-	20	-	-
vanillaextract	1tsp(5ml)	12	-	1.3	-	-
Total		**1.95kacl**	**16.45g**	**78.8g**	**28g**	**40.5g**

TABLE-III
MACRONUTRIENTCOMPOSITIONOFVARIATION-II(X3)

INGREDIENTS	AMOUNT (g)	ENERGY (Kcal)	PROTEIN (g)	CHO (g)	FIBER (g)	FAT (g)
cocoa beans powder	70g	159.6	13.7	40.5	25.9	9.6
cocoabutter,	30g	265.2	-	-	-	30
Kodomillet	40g	140.4	4.4	27.2	3.4	1.44
Sugar	20g	77.4	-	20	-	-
vanillaextract	1tsp(5ml)	12	-	1.3	-	-
Total		**654.6kacl**	**18.1g**	**89g**	**29.3g**	**41.04g**

ii) MACRONUTRIENTFOR WHITECHOCOLATE

TABLE-IV
MACRONUTRIENTCOMPOSITIONOFSTANDARD(X4)

INGREDIENTS	AMOUNT (g)	ENERGY (Kcal)	PROTEIN (g)	CHO (g)	FIBER (g)	FAT (g)
Milkpowder	100g	496	26	38	-	27
Cocobutter	30g	265.2	-	-	-	30
Powdered Sugar	20g	77.4	-	20	-	-
vanillaextract	1tsp(5ml)	12	-	1.3	-	-
Total		**850.6kcal**	**26g**	**59.3g**	**-**	**57g**

TABLE-V
MACRONUTRIENTCOMPOSITIONOFVARIATION-I(X5)

INGREDIENTS	AMOUNT (g)	ENERGY (Kcal)	PROTEIN (g)	CHO (g)	FIBER (g)	FAT (g)
Milkpowder	100g	496	26	38	-	27
Cocobutter	30g	265.2	-	-	-	30
Kodomillet	25g	87.75	2.75	17	2.1	0.9
PowderedSugar	20g	77.4	-	20	-	-
vanillaextract	1tsp(5ml)	12	-	1.3	-	-
Total		**938.35kcal**	**28.75g**	**76.3g**	**2.1g**	**57.9g**

TABLE-VI
MACRONUTRIENTCOMPOSITIONOFVARIATION-II(X6)

INGREDIENTS	AMOUNT (g)	ENERGY (Kcal)	PROTEIN (g)	CHO (g)	FIBER (g)	FAT (g)
Milkpowd	100g	496	26	38	-	27

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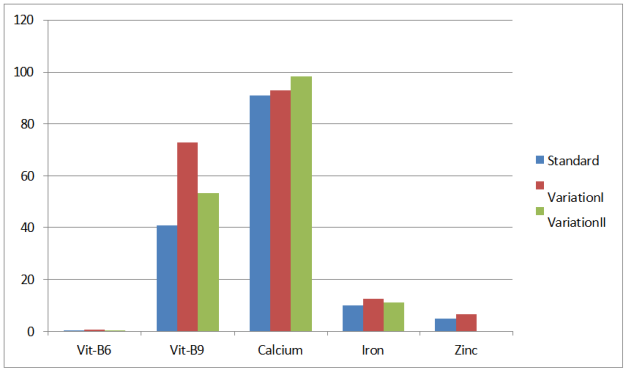
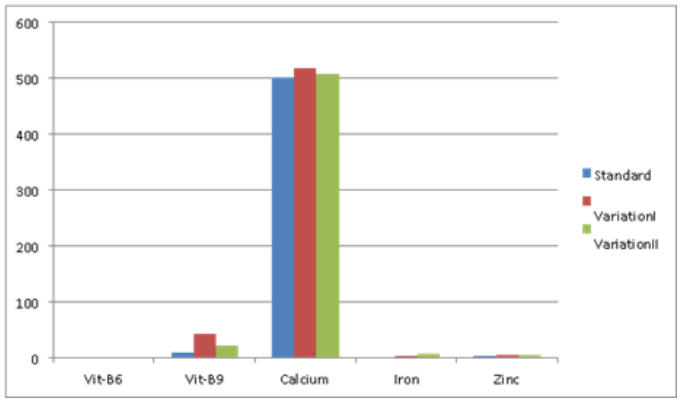
Cocobutter	30g	265.2	-	-	-	30
Kodomillet	40g	140.4	4.4	27.2	3.4	1.44
Powdered Sugar	20g	77.4	-	20	-	-
vanillaextract	1tsp(5ml)	12	-	1.3	-	-
Total		**795kcal**	**30.4g**	**86.5g**	**3.4g**	**58.44g**



FIGUREI
MICRONUTRIENTCOMPOSITIONOFDARKCHOCOLATE



FIGUREII
MICRONUTRIENTCOMPOSITIONOFWHITECHOCOLATE

4.1.1 EVALUATIONOFPHYSICALPARAMETERS

The physicaland phytochemical qualityanalysis were carried out for most acceptable Variation (X2) selected by the panelists.

Moisture

The moisture was tested using variation II (X2)
Weightofthe bottle =27.99
Weightofthe sample =5.5
Weight of the sample+bottle = 33.49
Weight ofthe sample + bottle after heating= 33.27
Loss inweight =0.22g
100gofchocolatecontain =0.22/5.5x100
=4g
Themoisturepresentin100gofkodomilletchocolate(x2)is4g

Weight:

Theweightofthedevelopedchocolatewasdeterminedusingananalyticalbalance.Theweightof developed chocolate is given in below table

Diameter:

The diameter ofthe developed chocolate was measured witha calibrated ruler. Allthe variations are in uniform diameter of 2.4 cm.

Thickness:

Thicknessof thedevelopedchocolatewasmeasuredwith acalibratedruler.All thevariationsarein uniform1.5 cm.

Variations	Diameter(cm)
X1	2.4
X2	2.4
X3	2.4
X4	2.4
X5	2.4
X6	2.4

Variations	Thickness of onechocolate (cm)
X1	1.5
X2	1.5
X3	1.5
X4	1.5
X5	1.5
X6	1.5

ANALYSISOFPHYTOCHEMICALQUALITY

Thesetestswereperformedwith hot waterextractofthesample.

TABLE –VII
PHYTOCHEMICALSCREENINGOFKODOMILLETCHOCOLATE

NAMEOFTHETESTS	RESULTS	
Phenoliccompounds	Presence	+
Proteins	Presence	+
Carbohydrates	Presence	+
Saponins	Presence	+
Flavonoids	Presence	+
Alkaloids	Absence	-

TABLE –IX
SENSORYEVALUTIONFOR DARKCHOCOLATE

VARIATIONS	Standard(X1)	VariationI(X2)	VariationII(X3)
APPEARANCE	4.9±0.1	4.9±0.3	4.83±0.3
COLOUR	4.9±0.18	4.9±0.3	4.86±0.3
TASTE	4.65±0.4	4.66±0.4	4.16±0.5
TEXTURE	4.83±0.1	4.83±0.3	4.6±0.6
FLAVOUR	4.8±O.3	4.76±0.4	4.46±0.6
OVERALL ACCEPTABILITY	4.81±O.1	4.86±0.3	4.46±0.5

TABLE – X
SENSORY EVALUATION OF WHITE CHOCOLATE

VARIATIONS	Standard(X4)	VariationI(X5)	VariationII(X6)
APPEARANCE	4.93±0.2	4.86±0.3	4.66±0.5
COLOUR	4.8±0.3	4.9±0.2	4.6±0.4
TASTE	4.9±0.1	4.7±0.4	4.3±0.6
TEXTURE	4.9±0.6	4.9±0.3	4.6±0.3
FLAVOUR	4.9±0.2	4.9±0.3	4.4±0.5
OVERALL ACCEPTABILITY	4.8±0.3	4.9±0.3	4.4±0.6

V. CONCLUSION

Kodo millet incorporated with dark and white chocolate offers a unique combination of tasteandhealthbenefits, making it asuperior choicecomparedto plainchocolate. Kodo millet with dark and white chocolate is a more nutrient-dense and gut-friendly optionthanplain chocolate, offering the best ofbothworlds delicious tasteand significant health benefits.For darkChocolatevaryintheir nutritionalcontent but allsharearichcombinationoffat, fiber, and carbohydrates. X1 (STANDARD) is the most energy-dense, offering a higher protein and fat content, with milk powder contributing the most proteinand cocoa butter providing most ofthefat.X2(VARIATION-I)islowerincaloriesandfatbuthasthehighestfibercontentprimarily from cocoa powder. It also provides protein and carbohydrates from Kodo millet. X3(VARIATION -II) offers a balanced nutrient profile with moderate protein, fat, and fiber, providing a combination of cocoa powder, cocoa butter, and Kodo millet for a well-rounded mixture. Overall, X1 is protein- and fat-rich, X2 is the most fiber-dense, andX3 provides a balanced combination of nutrients while maintaining the rich, chocolatey flavor.For white chocolate vary in their nutritional content, especially in calories, protein, fat, and carbohydrates. X4(STANDARD) isthe most moderate incalories, providing a good balance of fat and protein, with milk powder contributing the primary protein and cocoa butter offering most ofthe fat. It includes powdered sugar for sweetness and vanilla extract for flavor, but lacks fiber. X5(VARIATION -I)hasthe highest calorie count,featuring a balanced mixofprotein, fat, and carbohydrates. It includes Kodo millet, which adds extra protein, carbs, and a small amount of fiber, making it more nutrient-dense. X6 (VARIATION -II) is similar to X4 but has slightly more carbohydrates and includes Kodo millet, which provides fiber. This version is high in fat and protein, with a bit more fiber compared to X4. Overall, X5 is the most nutrient-dense, with the highest calories and added Kodo millet, while X4 is the lowest in calories but rich in fat and protein. X6 offers a balanced mix of nutrients with moderate calories, fiber, and carbohydrates.

In terms of **shelf life**, **Kodo millet chocolate** maintains its quality, including flavor, texture, and consistency, for up to **three weeks**. However, at **room temperature**, the chocolate spoils quickly. To extend its shelf life, it should be stored in the **refrigerator at 70°C**, where its quality is preserved for a longer period. Proper storage conditions are essential for maintaining the chocolate's freshness and preventing spoilage.

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