



Preparation, Packaging and Storability Analysis of Fortified Cupcakes Prepared for Preschool Children

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Today, maintaining optimal diet and health is the most difficult and demanding task. The importance of adding nutritious ingredients that are high in iron, calcium, fiber, protein, and other nutrients to food products has increased as people become more conscious of the role that food plays in health promotion. All age groups of people enjoy cupcakes because they are convenient, but children particularly enjoy them. Because they are convenient and appealing to kids. Numerous

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research has examined the idea of incorporating healthy components into cupcakes to improve their nutritional value. Cupcakes made with soy, ragi, and gram flour have the potential to be nutrient carriers. Keeping these above facts in view, the present investigation entitled "Preparation, Packaging and Storability Analysis of Fortified Cupcakes Prepared for Preschool Children" was carried out. The cupcakes were prepared by using whole wheat flour, refined wheat flour, baking soda, baking powder and finger millet flour/chickpea flour/ Soybean flour, oil, vanilla essence, icing sugar, milk powder and milk. Bakery goods frequently contain preservatives to increase their shelf life. Preservatives aid in halting the development of bacteria and mould, which can lead to food spoiling and food poisoning. Common preservatives found in cupcakes and bakery goods include calcium propionate, potassium sorbate, and sodium propionate. However, when these preservatives are used more than the permitted amount may lead to numerous health issues such as asthma, hyperactive behaviour in children, weakening of the heart, skin rashes, increased risk of obesity etc. In this study, no such harmful preservatives have been used in preparation of fortified cup-cakes. Permitted amount of preservatives has been used in this research. To balance the Leavening agents like Baking Soda and Baking Powder used in Bakery products, we may add acidic ingredients like Yogurt or Buttermilk to it. For sensitive individuals, we can use Natural leavening agents like Yeast, Milk, Curd, Egg etc. The finger millet-fortified cupcakes can be kept for up to four days without substantially compromising their sensory appeal. It was found that compared to aluminium foil, plastic pouches significantly impacted sensory characteristics as flavour and colour. All the organoleptic properties of the control and the enriched cupcakes made with Bengal gram and soybean flour dramatically improved with longer storage intervals. The results of the present study suggests that the cupcakes enhanced with Bengal gram and soybean flour could be stored for a maximum of four days without experiencing a substantial alteration in their sensory appeal. It was discovered that taste and flavour perceptions varied considerably more in paper envelopes than in aluminium foil.

Keywords: Cupcake; packaging; storability; nutritional value; fortified flour.

1. INTRODUCTION

These days, the most challenging and hard chore is keeping an ideal diet and state of health. As people grow more aware of the role that food plays in promoting health, the significance of adding nutrient-dense foods that are high in iron, calcium, fibre, protein, and other nutrients to food products has increased. Cupcakes are a convenient treat for people of all ages, but kids especially love them. Cupcakes are becoming more and more popular since they are kid-friendly and convenient. It's easy to fortify the flour with components high in protein and calcium to give kids convenient foods. Several studies have investigated the possibility of adding nutritious ingredients to cupcakes to increase their nutritional content [1,2]. Cupcakes made with soy, ragi, and Bengal gram flour have the potential to be nutrient carriers. It's possible for soy, ragi, and gramme flour cupcakes to act as nutrient transporters. Soybeans are the members of the leguminous family and have been used as a staple food in Asian cuisines for thousands of years [3-7]. Soy and soy foods are popular especially among people who are vegetarians and vegans in their diet. This is due to their high-quality protein content and their

ability to be incorporated with milk and meat substitutes. Soy is High in Protein, Fiber, Calcium and other Micronutrients. Ragi is also known as Finger Millet. It is rich in Protein, Calcium, Fiber, Iron and other Micronutrients. It is called "Poor Man's Milk". It is Gluten free so Celiac disease patients can also take it in their diet [8-10]. As it is gluten free, so bloating and Flatulence issues will not be there while Gluten rich Products like Roti, Puri, Paratha, Bread etc can cause bloating or flatulence problem. Bengal gram flour is also known as besan and has been used as a staple food in Indian cuisines for centuries. It is rich in Protein, Fiber, Calcium, Iron and Antioxidants [10-16]. It is having Low Carbs and Low Glycaemic Index (GI) Therefore, it is a good substitute of White Rice and Wheat Flour for Diabetes Patients. It is Low in Calorie so; it can be a healthier choice for Obese Individuals also.

Compared to cupcakes created with kid-friendly ingredients, commercially produced white flour cupcakes are lower in nutrients. India has twenty percent of its population under the age of six. As the child grows more mobile throughout the second year of life, activity also increases dramatically. Nutrition deficit remains one of the

most dangerous conditions for children before they reach school age and is the main cause of their deaths in many Arabian countries with low to medium wages and high rates of the condition, which affects over a third of the world's population. (2015) Aldeen and others. Since kids are eating a lot of sweetened food products at this stage of growth that have low nutrient values while kids need the important nutrients for growth, we tried to introduce food products that were enhanced by good nutrient value needed by kids for growth and doing the daily activities with optimum form. Because millets are rich in antioxidants, phytochemicals, and other health-promoting components, they are used in many different types of culinary preparations [17-20].

Food products can deteriorate in several ways during the distribution, storage, and consumption processes. As a result, maintaining the products' stability throughout distribution, shipping, and storage is essential. Studies on the self-life of products enable manufacturers to guarantee that customers will obtain high-quality goods for an extended period after creation. Considering the aforementioned information, the current study entitled "packaging and storability analysis of fortified cupcakes prepared for preschool children" was conducted with an aim to evaluate the its packaging and storability.

2. MATERIALS AND METHODS

The present investigation entitled "Packaging and Storability analysis of Fortified Cupcake Prepared for Preschool Children" carried out with the objectives to analyse the packaging and storability of fortified cupcake prepared for

preschool children. the exploration process has been precisely described under the following headings and subheadings:

- I. Procurement of raw materials
- II. Standardization of different flour for preparation of Cupcake
- III. Procedure for preparation of fortified cupcake
- IV. Storability study of developed product

2.1 Procurement of Raw Materials

The whole wheat flour, finger millet flour, and gram flour were all obtained at the local market in Siripur, Bhubaneswar.

2.2 Standardization of Different Flour for Preparation of Cupcake

Seven distinct varieties of composite flour were created by mixing finger millet flour (FMF), soy flour (SF), Bengal gram flour (BGF), refined wheat flour (RWF), and whole wheat flour (WWF), as illustrated in the following Table 1.

2.3 Procedure for Preparation of Fortified Cupcake

Sunflower oil, icing sugar, vanilla extract, milk, and milk powder are combined until smooth and light. Instead, combine whole wheat flour, refined wheat flour, baking soda, and baking powder. Next, combine the wet and dry components. Put cupcake liners inside the cupcake tin. Fill the muffin liners with the batter. Bake the cupcakes at 160°C for 25 minutes. Take them out of the pan when they have cooled for a few minutes.

Table 1. Standardization of different flour for preparation of cupcake

	Composition sample code						
	C ₀	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆
Refined wheat flour	50g	28g	28g	28g	28g	28g	28g
Whole wheat flour	50g	28g	28g	28g	28g	28g	28g
Soy flour	-	44g	-	-	22g	-	22g
Bengal gram flour	-	-	44g	-	22g	22g	-
Finger millet flour	-	-	-	44g	-	22g	22g

2.4 Storability Study of Developed Product

Storability study of of developed cupcakes in different packaging materials to evaluate the sensory qualities and storability, the created cupcakes of different blends were packaged in polypropylene pouches, paper envelope and aluminium foil Using a hand-operated sealing machine, the packing materials were sealed, and samples of the various packaging materials were collected for analysis at intervals of two days up to eight days.

3. RESULTS AND DISCUSSION

Every 2 days for up to 8 days of storage, 10 semi-trained panel members assessed the generated items' organoleptic storability for a wide range of quality parameters, including appearance, taste, texture, colour, and overall acceptability.

At the second day of storage, the C0, C3, C4, and C5 fortified cupcakes' mean sensory parameter colour scores were 8.5, 7.5, 8.5, and 8.5, respectively. However, the mean scores substantially reduced as storage durations, such as the fourth, sixth, and eighth days, increased. The average scores of C0, C3, C4, and C5 stored in aluminium foil fell to 8, 6.5, 7.5, and 7 correspondingly after 8 days of storage.

At the second day of storage, the C0, C3, C4, and C5 fortified cupcakes had mean sensory parameter texture ratings of 8.5, 8.5, 7.5, and

8.5, respectively. However, the mean scores substantially reduced as storage durations, such as the fourth, sixth, and eighth days, increased. The average scores of C0, C3, C4, and C5 stored in aluminium foil fell to 5, 5.5, 6, and 5.5, respectively, after 8 days of storage.

The sensory parameter flavour of the fortified cupcakes with the C0, C3, C4, and C5 had mean scores of 8, 8, 4.5, and 7 on the second day of storage, however the mean scores substantially declined as storage times increased, i.e., on the fourth, sixth, and eighth days. The average scores of C0, C3, C4, and C5 stored in aluminium foil fell to 6.5, 7, 7, and 6 correspondingly after 8 days of storage.

At the second day of storage, the C0, C3, C4, and C5 fortified cupcakes had mean sensory parameter scores of 8, 8.5, 4.5, and 5.5, respectively. However, the mean scores substantially reduced as storage durations, such as the fourth, sixth, and eighth days, increased. The average scores of C0, C3, C4, and C5 maintained in aluminium foil fell to 6.5, 5.5, 6.5, and 5.5 accordingly after 8 days of storage.

At the second day of storage, the C0, C3, C4, and C5 fortified cupcakes' respective mean scores for the sensory parameter colour were 8.5, 7.6, 6.5, and 6.5, respectively. However, the mean scores significantly decreased as storage durations, such as the fourth, sixth, and eighth days, increased. The average scores of C0, C3, C4, and C5 maintained in aluminum foil fell to 6.5, 6.5, 7.5, and 4 correspondingly after 8 days of storage.

Table 2. Ingredients required for cupcake

Name of the ingredients	Amount
Whole wheat flour	50 g
Refined wheat flour	50g
Milk	80 ml
Milk powder	10 g
Baking soda	1.5 g
Baking powder	3 g
Oil	46 ml
Icing sugar	50 gm
Vanilla essence	1 tsp

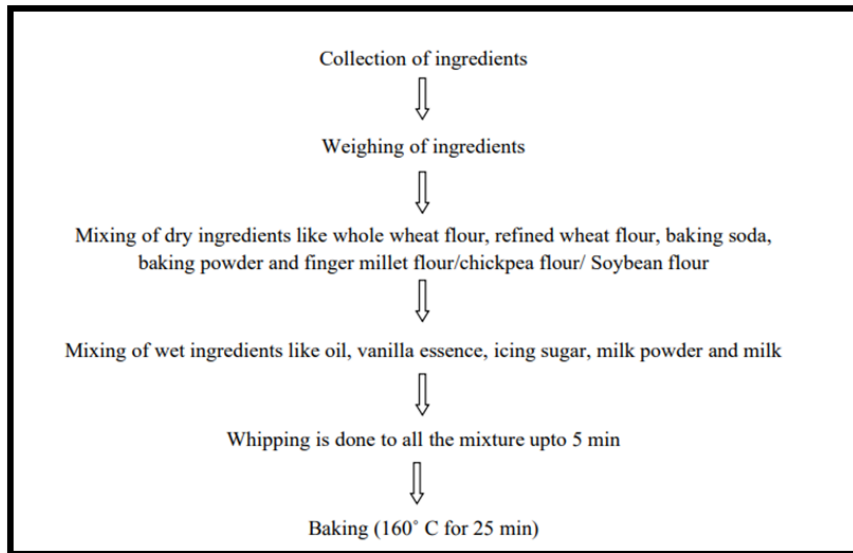


Fig. 1. Flowchart of cupcake preparation



Fig. 2. Preparation of Fortified Cupcake



Fig. 3. Types of Packaging Material

Table 3. Storability study of cupcake in aluminium foil

Aluminum foil				
Color				
	Day-2	Day-4	Day-6	Day-8
C ₀	8.5±0.17	8.5±0.17	8.5±0.17	8±0.33
C ₃	7±0.00	6±0.00	8±0.33	6.5±0.17
C ₄	7.5±0.50	6.5±0.83	7±0.67	7.5±0.10
C ₅	8.5±0.17	7.5±0.50	7±0.67	7±0.67
Texture				
	Day-2	Day-4	Day-6	Day-8
C ₀	8.5±0.17	8.5±0.17	8±0.33	5±0.67
C ₃	8.5±0.17	7.5±0.17	8±0.33	5.5±0.50
C ₄	7.5±0.17	6.5±0.50	5.5±0.50	6±0.33
C ₅	8.5±0.17	7.5±0.50	7±0.67	5.5±0.17
Flavor				
	Day-2	Day-4	Day-6	Day-8
C ₀	8±0.33	8±0.33	8±0.33	6.5±0.5
C ₃	8±0.00	7±0.00	7.5±0.17	7±0.33
C ₄	4.5±0.17	3±0.33	4.5±0.83	7±0.33
C ₅	7±0.67	6±1.00	6.5±0.17	6±0.67
Taste				
	Day-2	Day-4	Day-6	Day-8
C ₀	8±0.33	8±0.33	8±0.33	6±0.33
C ₃	8.5±0.17	7.5±0.17	8±0.33	5.5±0.17
C ₄	4.5±0.17	3±0.33	4.5±0.83	6.5±0.17
C ₅	5.5±0.17	3.5±0.17	7±0.33	5.5±0.50
<p>Note: Values are mean ± SE of three independent replications. Control(C₀)-RWF:WWF(50:50), C₃-RWF:WWF:SF(28:28:44), C₄-RWF:WWF:SF:BGF(28:28:22:22), C₅-RWF:WWF:BGF:FMF(28:28:22:22), RWF- Refined wheat flour, WWF-Whole wheat flour, FMF-Finger millet flour, GF-Gram flour, SF-Soy flour</p>				

At the second day of storage, the fortified cupcakes with C₀, C₃, C₄, and C₅ had mean sensory parameter texture ratings of 8.5, 8.5, 8.5, and 8 correspondingly. However, when storage times increased to the fourth, sixth, and eighth days. The mean scores significantly reduced. The average scores of C₀, C₃, C₄, and C₅ stored in aluminum foil fell to 5, 6, and 5 accordingly after 8 days of storage.

The C₀, C₃, C₄, and C₅ nutritionally enhanced cupcakes had mean sensory parameter flavour scores of 9, 8, 5.5, and 7.5 at the 2nd day of

storage, respectively. However, the mean scores substantially declined when storage times, i.e., 4th, 6th and 8th days, increased. The average scores of C₀, C₃, C₄, and C₅ stored in aluminium foil fell to 6, 7, 5, and 5 correspondingly after 8 days of storage.

The average sensory parameter taste rating for C₀, C₃, C₄, and C₅ fortified cupcakes were 9, 8.5, 7, and 7 respectively on the second day of storage; however, the average ratings significantly declined as storage times increased, i.e., on the fourth, sixth, and eighth days. The

average scores of C0, C3, C4, and C5 stored in aluminium foil fell to 4, 5.5, 5, and 4 accordingly after 8 days of storage.

At the second day of storage, the C0, C3, C4, and C5 fortified cupcakes had mean scores for the sensory parameter colour of 9, 9, 8.5, and 8.5, respectively. However, the mean scores substantially reduced as storage durations, such as the fourth, sixth, and eighth days, increased. The average scores of C0, C3, C4, and C5 maintained in paper envelop dropped to 7, 6, 6, and 5.5 respectively after 8 days of storage.

At the second day of storage, the nutritionally enhanced cupcakes C0, C3, C4, and C5 had mean sensory parameter texture scores of 8.5,

8.5, and 8.5, respectively. However, as storage times, i.e. the fourth, sixth, and eighth days, increased, the mean scores significantly reduced. The mean scores of C0, C3, C4, and C5 stored in paper envelop fell to 4.5, 5.5, 5.5, and 5.5 accordingly after 8 days of storage.

The mean score for sensory parameter flavour of C0, C3, C4 and C5 nutritionally fortified cupcake were 8.5,7.5,8.5 and 8 respectively at 2nd day of storage whereas the mean scores were significantly decreased with increase with the storage durations i.e. 4 th,6th,8th days. In 8th days of storage, the mean scores of C0, C3, C4 and C5 kept in paper envelop were decreased to 6, 6,4 and 4 respectively.

Table 4. Storability study of cupcake in plastic pouch

Plastic pouch				
Colour				
	Day-2	Day-4	Day-6	Day-8
C ₀	9±0	8.5±0.17	8.5±0.17	6.5±0.17
C ₃	8±0.33	7.5±0.50	7±0.67	6.5±0.83
C ₄	8.5±0.17	7.5±0.50	6.5±0.50	7.5±0.50
C ₅	7.5±0.50	7±0.67	6.5±0.83	4±0.00
Texture				
	Day-2	Day-4	Day-6	Day-8
C ₀	8.5±0.17	8±0.33	8±0.33	5±0.33
C ₃	8.5±0.17	7.5±0.17	7±0.67	6±0.67
C ₄	8.5±0.17	7.5±0.17	6.5±0.50	6±0.67
C ₅	8±0.33	7.5±0.50	6.5±0.83	5±0.33
Flavor				
	Day-2	Day-4	Day-6	Day-8
C ₀	9±0.00	8.5±0.17	8±0.33	6±0.00
C ₃	8±0.00	7±0.00	7.5±0.50	7±0.33
C ₄	5.5±0.50	4±0.67	4±0.67	5±1.00
C ₅	7.5±0.50	6.5±0.83	7±0.33	5±1.00
Taste				
	Day-2	Day-4	Day-6	Day-8
C ₀	9±0.00	8.5±0.17	8.5±0.17	4±0.67
C ₃	8.5±0.17	7.5±0.17	7.5±0.50	5.5±0.83
C ₄	7±0.67	5±1.00	4.5±0.83	5±1.00
C ₅	7±0.67	6.5±0.83	7.5±0.50	4±1.00
<p>Note: Values are mean ± SE of three independent replications. Control(C0)-RWF:WWF(50:50), C3-RWF:WWF:SF(28:28:44), C4-RWF:WWF:SF:BGF(28:28:22:22), C5-RWF:WWF:BGF:FMF(28:28:22:22), RWF- Refined wheat flour, WWF-Whole wheat flour, FMF-Finger millet flour, GF-Bengal gram flour, SF-Soy flour</p>				

Table 5. Storability study of cupcake in paper envelope

Paper envelop				
Color				
	Day-2	Day-4	Day-6	Day-8
C ₀	9±0	8.5±0.17	8±0.33	7±0.33
C ₃	9±0	8.5±0.17	7±0.67	6±0.67
C ₄	8.5±0.17	8±0.33	3.5±0.17	6±0.00
C ₅	8.5±0.17	8±0.33	7±0.67	5.5±0.50
Texture				
	Day-2	Day-4	Day-6	Day-8
C ₀	8.5±0.17	8±0.33	5±0.33	4.5±0.17
C ₃	8±0.33	7±0.33	4±0.33	5.5±0.50
C ₄	8.5±0.17	7.5±0.17	4±0.33	5.5±0.50
C ₅	8.5±0.17	8±0.33	4.5±0.17	5.5±0.50
Flavor				
	Day-2	Day-4	Day-6	Day-8
C ₀	8.5±0.17	7.5±0.17	7.2±0.33	6±0.00
C ₃	7.5±0.17	6.5±0.17	7.4±0.45	6±0.00
C ₄	8.5±0.17	7.5±0.17	7.1±0.62	4±0.67
C ₅	8±0.00	7.5±0.17	6±0.42	4±0.67
Taste				
	Day-2	Day-4	Day-6	Day-8
C ₀	8.5±0.17	8±0.33	7.2±0.36	4±0.67
C ₃	7.5±0.17	6.5±0.17	7.3±0.40	5±0.67
C ₄	8±0.33	7.5±0.50	7.1±0.31	4.5±0.83
C ₅	7.5±0.17	7±0.33	7±0.33	4±1.00
<p>Note: Values are mean ± SE of three independent replications. Control(C₀)-RWF:WWF(50:50), C₃-RWF:WWF:SF(28:28:44), C₄- RWF:WWF:SF:BGF(28:28:22:22), C₅-RWF:WWF:BGF:FMF(28:28:22:22), RWF- Refined wheat flour, WWF-Whole wheat flour, FMF-Finger millet flour, BGF-Bengal gram flour, SF-Soy flour</p>				

The C₀, C₃, C₄ and C₅ nutritionally enhanced cupcakes had mean sensory parameter taste ratings of 8.5, 7.5, 8 and 7.5, respectively, on the second day of storage. However, the mean scores substantially declined ($p < 0.01$) as storage times increased, i.e., on the 4th, 6th, and 8th days. The mean scores of the C₀, C₃, C₄ and C₅ maintained in paper envelop were reduced to 4, 5, 4.5 and 4 accordingly after 8 days of storage.

Storability of fortified cupcakes: The current investigation's findings indicate that the finger millet-fortified cupcakes can be kept for up to four days without substantially compromising their sensory appeal. It was found

that sensory characteristics including flavour and hue were significantly more impacted by plastic pouches than by aluminium foil. Ladkat et al. (2019).

All the organoleptic properties of the fortified cupcakes made with soybean and Bengal gram flour as well as the control considerably improved when storage intervals at days two, four, six, and eight increased. According to the results of the current investigation, the cupcakes fortified with soybean and gram flour were acceptable up to four days of storage periods without experiencing any appreciable alterations in sensory acceptability. It was discovered that compared to aluminium foil, the sensory attribute flavour and

taste varied substantially more in paper envelopes. Ramjaon (2013) *et al.* reported similar findings. In fourth day of storing, the microbial load for the fortified cupcakes C0, C3, C4, and C5 were 1.2×10^3 cfu/gm, 0.8×10^3 cfu/gm, 5.2×10^3 cfu/gm, and 1.6×10^3 cfu/gm, respectively. For the sixth day, the bacterial counts for the fortified cupcakes C0, C3, C4, and C5 were 2.3×10^3 cfu/gm, 1.1×10^3 cfu/gm, 6.2×10^3 cfu/gm, and 2.1×10^3 cfu/gm, respectively.

The C4 fortified cupcake had the highest score, 6.2×10^3 , and the C3 cupcake received the lowest score, 1.1×10^3 , out of the four formulations. Score of microbial load of C0, C3, C4, C5 fortified cupcakes in 8 th day were 3.5×10^3 cfu/gm, 2.1×10^3 cfu/gm, 7.2×10^3 cfu/gm and 2.9×10^3 cfu/gm respectively. C4 fortified cupcake scored maximum score i.e. 7.2×10^3 cfu/gm and C3 scored minimum score among all four cupcakes i.e. 2.1×10^3 cfu/gm.

Table 6. Comparative analysis between day’s interval and composition of cupcake in aluminium foil

Aluminum foil						
		color	Texture	Flavor	Taste	Overall acceptability
2 nd day	C ₀	8.5	8.5	8	8	8.25
	C ₃	7	8.5	8	8.5	8
	C ₄	7.5	7.5	4.5	4.5	6
	C ₅	8.5	8.5	7	5.5	7.4
4 th day	C ₀	8.5	8.5	8	8	8.2
	C ₃	6	7.5	7	7.5	7
	C ₄	6.5	6.5	3	3	4.7
	C ₅	7.5	7.5	6	3.5	6.1
6 th day	C ₀	8.5	8	8	8	8.1
	C ₃	8	8	7.5	8	7.8
	C ₄	7	5.5	4.5	4.5	5.4
	C ₅	7	7	6.5	7	6.8
8 th day	C ₀	8	5	6.5	6	6.3
	C ₃	6.5	5.5	7	5.5	6.1
	C ₄	7.5	6	7	6.5	6.7
	C ₅	7	5.5	6	5.5	6
<p>Note: Values are mean ± SE of three independent replications. Control(C0)-RWF:WWF(50:50), C3-RWF:WWF:SF(28:28:44), C4-RWF:WWF:SF:BGF(28:28:22:22), C5-RWF:WWF:BGF:FMF(28:28:22:22), RWF- Refined wheat flour, WWF-Whole wheat flour, FMF-Finger millet flour, BGF-Bengal gram flour, SF-Soy flour</p>						

Table 7. Comparative analysis between days interval and composition of cupcake in plastic pouch

Plastic pouch						
		color	Texture	Flavour	Taste	Overall acceptability
2 nd day	C ₀	9	8.5	9	9	8.8
	C ₃	8	8.5	8	8.5	8.2
	C ₄	8.5	8.5	5.5	7	7.4
	C ₅	7.5	8	7.5	7	7.5
4 th day	C ₀	8.5	8	8.5	8.5	8.4
	C ₃	7.5	7.5	7	7.5	7.4
	C ₄	7.5	7.5	4	5	6
	C ₅	7	7.5	6.5	6.5	6.8
6 th day	C ₀	7	8	8	8.5	7.8
	C ₃	6.5	7	7.5	7.5	7.1
	C ₄	6.5	6.5	4	4.5	5.4
	C ₅	6.5	6.5	7	7.5	6.8
8 th day	C ₀	6.5	5	6	4	5.4
	C ₃	6.5	6	7	5.5	6.2
	C ₄	7.5	6	5	5	5.8
	C ₅	4	5	5	4	4.5
<p>Note: Values are mean ± SE of three independent replications. Mean with same superscript (a, b, c, d) in the same column differ significantly (p>0.05). Control(C0)-RWF:WWF(50:50), C3-RWF:WWF:SF(28:28:44), C4-RWF:WWF:SF:GF(28:28:22:22), C5-RWF:WWF:GF:FMF(28:28:22:22), RWF- Refined wheat flour, WWF-Whole wheat flour, FMF-Finger millet flour, GF-Gram flour, SF-Soy flour</p>						

With increased storage intervals at the second, fourth, sixth, and eighth days, all the organoleptic properties of the enriched cupcakes manufactured with finger millet flour and Bengal gramme flour, as well as the control, significantly improved. The current investigation's findings indicate that the enriched cupcake goods manufactured with finger millet flour and Bengal gramme flour were acceptable for storage for up to four days without significantly changing their sensory acceptability. It was shown that compared to the aluminium foil, the plastic pouch

experienced far fewer flavour and texture alterations. (Rohi *et al.* 2022).

The mean score for sensory parameter flavor of C₀, C₃, C₄ and C₅ nutritionally fortified cupcake were 8.5,7.5,8.5 and 8 respectively at 2nd day of storage whereas the 4th mean scores were significantly decreased with increase with the storage durations i.e. 4th,6th,8th days. In 8th days of storage the mean scores of C₀, C₃, C₄ and C₅ kept in paper envelop were decreased to 6, 6,4 and 4 respectively.

Table 8. Comparative analysis between days interval and composition of cupcake in paper envelope

Paper envelop						
		colour	Texture	Flavour	Taste	Overall acceptability
2 nd day	C0	9	8.5	8.5	8.5	8.6
	C3	9	8	7.5	7.5	8
	C4	8.5	8.5	8.5	8	8.4
	C5	8.5	8.5	8	7.5	8.1
4 th day	C0	8.5	7	6.5	6.5	7.1
	C3	8	7.5	7.5	7.5	7.6
	C4	8	8	7.5	7	7.6
	C5	8	5	7.2	7.2	6.8
6 th day	C0	8	5	7.2	7.2	6.8
	C3	7	4	7.4	7.3	6.4
	C4	3.5	4	7.1	7.1	5.4
	C5	7	4.5	6	7	6.1
8 th day	C0	7	4.5	6	4	5.4
	C3	6	5.5	6	5	5.6
	C4	6	5.5	4	4.5	5
	C5	5.5	5.5	4	4	4.7
<p>Note: Values are mean ± SE of three independent replications. Mean with same superscript (a, b, c, d) in the same column differ significantly (p>0.05). Control(C0)-RWF:WWF(50:50), C3-RWF:WWF:SF(28:28:44), C4-RWF:WWF:SF:GF(28:28:22:22), C5-RWF:WWF:GF:FMF(28:28:22:22), RWF- Refined wheat flour, WWF-Whole wheat flour, FMF-Finger millet flour, GF-Gram flour, SF-Soy flour</p>						

The C0, C3, C4 and C5 nutritionally enhanced cupcakes had mean sensory parameter taste ratings of 8.5, 7.5, 8 and 7.5, respectively, on the second day of storage. However, the mean scores substantially declined ($p < 0.01$) as storage times increased, i.e., on the 4th, 6th, and 8th days. The mean scores of the C0, C3, C4 and C5 maintained in paper envelop were reduced to 4, 5, 4.5 and 4 accordingly after 8 days of storage. It was further observed that paper pouch is not suitable for storing of cupcakes since its overall acceptability was less than pp pouch storing materials.

4. SUMMARY AND CONCLUSION

Due to its palatability, flavour, convenience, nutritional content, and organoleptic value, cupcakes are regarded as food products in many nations. It is a suitable food for nutritional improvement when nutrients are supplemented by enrichment and fortification. Preschoolers are becoming more interested in cakes that have elements that are good for them. Consequently, it is an excellent chance to create and popularize nutrient-rich cupcakes among preschoolers at Angan Wadi Centres (AWCs) in our state.

According to the results of the current investigation, the finger millet-fortified cupcake may be stored without significantly affecting their sensory acceptability for up to four days. It was discovered that plastic pouches affected sensory attributes including flavour and colour substantially more than aluminium foil. It was discovered that compared to aluminium foil, the sensory attribute flavour and taste varied substantially more in paper envelopes.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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