



Formulation and quality evaluation of gluten free casein free cake mix flour for the children with autism spectrum disorder

Kavitha Raj KN^{1*}, Beela GK²

¹ PhD Scholar, Department of Community Science, College of Agriculture, Vellayani, Kerala Agricultural University, Kerala, India

² Associate Professor, Department of Community Science, College of Agriculture, Vellayani, Kerala Agricultural University, Kerala, India

Abstract

Dietary intervention as a tool for maintaining and improving physical health and wellbeing for Autism Spectrum Disorder is a widely researched and discussed topic. When following the gluten free casein free strict elimination diet, all foods containing gluten and casein are removed from the child's daily diet and studies show that it reduces the hypersensitivity to children with Autism spectrum disorder. This study was an attempt to develop gluten free casein free cake mix flour for children with autism spectrum disorder. The main ingredients of the cake mix flour was sprouted sorghum, red rice, banana flour, sweet potato flour, roasted bengal gram flour. The GFCF cake mix flour was prepared using the selected grains after processing. Six combinations of cake mix flour were prepared using processed sorghum, banana flour as well as sweet potato flour and roasted bengal gram flour along with processed red rice flour in different proportions. GFCF cake mix flour prepared with processed red rice flour was taken as the control. Chemical constituents like protein, carbohydrate, total minerals, calcium, sodium, potassium, iron and shelf life of formulated GFCF cake mix flour were estimated that all the GFCF cake mix flour were found to be nutritious than the control prepared exclusively with red rice flour and had good shelf life.

Keywords: gluten free, cake mix flour, autism spectrum disorder

Introduction

Autism Spectrum Disorder is a sensitive issue in today's medical and educational world. This cognitive condition draws so many people's attention because of the huge rise in the prevalence of autism spectrum disorder (Levy *et al.*, 2014) [11]. Autism spectrum disorder (ASD) is a developmental disorder defined by impairments in social interaction and communication and the presence of restricted interests and repetitive behaviors (RRB) (APA, 2013). Dietary intervention as a tool for maintaining and improving physical health and wellbeing for ASD is a widely researched and discussed topic. Studies have depicted that there is a link between diet, gut epithelial changes and altered immune response in the spectrum disorders exhibited by children with Autism (Byron, 1997) [2]. A gluten-free casein-free diet is also known as the GFCF diet. It is one of several alternative treatments for children with autism. When following this strict elimination diet, all foods containing gluten (found in wheat, barley and rye) and casein (found in milk and dairy products) are removed from the child's daily food intake. Foods that contained proteins such as gluten and casein causes hypersensitivity to children with ASD. The children cannot digest these proteins properly. This result to increase the level of urinary small peptides. These peptides bind to opioid receptors and become biologically active, which results excess of opioid and leads to an increase of the behavioral difficulties seen in the children (Hart *et al.*, 2015, Elder *et al.*, 2006, Herbert *et al.*, 2013) [3, 6, 7]. Dietary interventions with the exclusion of gluten, casein or both is thought to have a positive effect on behavioral symptoms because of the elevated levels of

peptides seen in the urinary analyses.(Mari *et al.*, 2014, Hyman *et al.*, 2010, Mulloy *et al.*, 2011) [8, 12] Since the chemical structure of gluten and casein are very similar to each other, it is very likely that having a sensitivity to one of them means having a sensitivity to both, even though one could be worse than the other (Reichelt, *et al.*, 1991) [13]. Kathleen *et al.*, (2010) [10] in her studies revealed that about 25% patients find relief and improvement with GFCF diet. In theory, kids improve on the diet because incomplete breakdown of these proteins create a substance that can inflame the gut. Due to elimination of diet, ASD children are at an increased risk of nutritional deficiencies and poor diet quality because of picky eating, limited dietary diversity and gastrointestinal (GI) symptoms.(Haris *et al.*, 2012, Kang *et al.*, 2014, Van *et al.*, 2014) [9, 15].

Cake is one of the always favorite food for all age groups. Children with ASD will also demand for cake on their birthdays. Most of the time children with ASD are restricted from cakes. Depriving cakes in childhood is a real challenge for the parents. Therefore making a cake for children with ASD is the real need for the hour. Hence this research was aimed to formulate a GFCF cake flour for children with ASD so that children with ASD also can enjoy cake without any health issues. Considering the fact that ASD children are not meeting the major nutrient requirement, this study was also evaluated the nutrient quality of the flour and shelf life of the cake mix flour.

Materials and Methods

Procurement of raw materials

Selection of the various constituents for the formulation of

GFCF cake mix flour was based on their gluten free casein free property and nutritional quality. The main ingredients of the cake mix flour was sprouted sorghum, red rice, banana flour, sweet potato flour, roasted Bengal gram flour. The ingredients were purchased from local market.

Processing of raw materials

Collected ingredients were cleaned and washed separately. For malting sorghum, the grain was soaked in cold water for 12 hours and the soaked grain was tied in a clean wet cloth for sprouting for 48 hours. Water was sprinkled every one hour. Then, the malted grain was dried in a hot air oven for six hours at a temperature of 60⁰ C. The dried grain was roasted at low temperature for five minutes and then the roasted grain was powdered and sieved through a sieve (Srilakshmi, 2003) ^[14]. The skin of raw banana and sweet

potato was removed and cut into thin slices. Then dried in a hot air oven for 50⁰ C. The dried bananas and sweet potatoes were powdered and sieved to get fine flour. Red rice and Bengal gram were roasted, powdered and sieved separately.

Formulation of GFCF cake mix flour

Six combinations of cake mix flour were prepared using processed sorghum, banana flour as well as sweet potato flour and roasted bengal gram flour along with processed red rice flour in different proportions. GFCF cake mix flour prepared with processed red rice flour was taken as the control. The prepared weaning foods were packed in aluminium laminated pouches and stored at ambient temperature for three months for storage study. The details of treatments used to formulate the GFCF cake mix flour are given in Table 1

Table 1: Treatments used to formulate the GFCF cake mix flour

Ingredients (gms)	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆
Red rice flour	200	25	-	70	25	-	70
Malted sorghum	-	115	140	70	115	140	70
Banana Flour	-	40	40	60	-	-	-
Sweet potato	-	-	-	-	40	40	60
Bengal gram	-	20	20	-	20	20	-

Nutrient Analysis

The nutritive qualities like carbohydrate, protein, sodium, potassium, calcium and phosphorus were estimated with standard procedures.

Microbial evaluation

The total microbial count of weaning foods was enumerated monthly intervals of three months of storage. For analyzing microbial count, pour plating technique was adopted. Nutrient agar (NA), Eosin Methylene Blue (EMB) agar and Rose Bengal (RB) agar medium were used for microbial analysis. The microbial load of the treated flour was expressed as cfu/g of the product.

Statistical Analysis

The observations recorded were tabulated and the data was analyzed statistically as Completely Randomized Design (CRD).

Results

Nutrient Analysis

The carbohydrate content of the GFCF cake mix flour ranged between 38.21 g to 69.21 g/100g. Lowest carbohydrate content was noticed in the GFCF cake mix flour prepared exclusively with red rice (T₀). As per the statistical data, the total carbohydrate content of GFCF cake mix flour prepared with 140 g malted sorghum, 40 g banana flour and 20 g of bengal gram flour (T₂) had the highest carbohydrate content (69.21 g/ 100 g) which had significant difference over other treatments prepared with sweet potato flour (T₄, T₅ and T₆). The lowest total carbohydrate content was noticed in GFCF cake mix flour exclusively prepared with rice flour (38.21 mg/100g). The protein content of

GFCF cake mix flours ranged between 8.60 g to 15.45 g/ 100 g. The highest value of protein was reported from T₂ (15.45 g/ 100 g) of GFCF cake mix flour prepared with banana flour, which was significantly different from GFCF cake mix flour prepared with sweet potato flour (T₄, T₅ and T₆). The lowest protein content was noticed in GFCF cake mix flour exclusively prepared with rice flour (8.60 g/ 100 g). The energy levels of GFCF cake mix flours ranged between 212.08 g to 316.30 g/ 100 g. The highest energy level was reported from T₃ (316.30 g/ 100 g) which was significant difference over GFCF cake mix flour prepared with sweet potato flour (T₄, T₅ and T₆). The lowest energy level was noticed in GFCF cake mix flour exclusively prepared with rice flour (212.08 g/ 100 g).The dietary fibre content of GFCF cake mix flours ranged between 3.16 g to 4.61 g/ 100 g. The GFCF cake mix flour prepared with banana flour, the results show that the dietary fibre content of GFCF cake mix flour prepared with 140 g malted sorghum, 40 g banana flour and 20 g of bengal gram flour (T₂) had the highest dietary fibre content (4.61 g/ 100 g). The lowest dietary fibre content was noticed in GFCF cake mix flour exclusively prepared with rice flour (3.16 g/ 100 g). Highest content of calcium, sodium, potassium and iron of 349.63 mg/ 100 g, 200.44 g/ 100 g, 445.88 mg/ 100 g and 8.55 mg/ 100 g were found in cake mix flour prepared with 140 g malted sorghum flour, 40 g banana flour and 20 g of bengal gram flour (T₂). Haleem (2015) [4] developed a gluten free casein free cupcakes by mixing rice flour, sweet potato, chick peas at different proportions. The result of the study indicates that they are rich in protein, carbohydrates and minerals compared with the control that is prepared exclusively with corn flour. The nutrient composition of formulated GFCF cake mix flour are given in Table 2.

Table 2: Nutrient composition of formulated GFCF cake mix flour

Treatments	CHO (g/100g)	Protein (g/100)	Energy (Kcal)	Dietary fibre (g/100g)	Calcium (mg/100g)	Sodium (mg/100g)	Potassium (mg/100g)	Iron (mg/100g)
T ₀	38.21 ±0.10	8.60 ± 0.03	212.08 ± 0.05	3.16 ± 0.03	202.84 ± 0.023	102.35 ± 0.015	130.52 ± 0.017	1.53 ± 0.255
T ₁	50.53 ±0.13	14.38 ± 0.03	312.78 ± 0.08	4.32 ± 0.03	331.24 ± 0.062	156.04 ± 0.018	421.60 ± 0.094	8.31 ± 0.027

T ₂	69.21 ± 0.05	15.45 ± 0.02	315.15 ± 0.05	4.61 ± 0.01	349.63 ± 0.122	162.89 ± 0.032	445.88 ± 0.070	8.55 ± 0.017
T ₃	57.43 ± 0.05	11.51 ± 0.03	316.30 ± 0.01	4.42 ± 0.01	312.84 ± 0.017	150.54 ± 0.023	411.21 ± 0.085	8.04 ± 0.065
T ₄	51.69 ± 0.14	11.68 ± 0.03	251.60 ± 0.06	4.18 ± 0.04	239.25 ± 0.053	180.05 ± 0.017	286.07 ± 0.079	6.44 ± 0.018
T ₅	46.54 ± 0.25	13.35 ± 0.03	240.41 ± 0.01	4.21 ± 0.01	294.42 ± 0.022	200.44 ± 0.049	297.86 ± 0.062	6.74 ± 0.015
T ₆	41.12 ± 0.05	11.30 ± 0.03	238.61 ± 0.06	4.03 ± 0.03	220.84 ± 0.023	188.24 ± 0.045	248.55 ± 0.029	6.24 ± 0.023
CD	0.40	0.10	0.15	0.08	0.125	0.388	0.164	0.309
SE (m)	0.13	0.03	0.05	0.02	0.041	0.127	0.053	0.101

Values are means of triplicates, SE (m): standard error of the mean

Microbial evaluation

During six months of storage period bacterial colonies were observed from Vth (1×10^7 cfu g⁻¹) and VIth month (2×10^7 cfu g⁻¹) in GFCF cake mix flour prepared with 70 g of rice flour, 70 g of malted sorghum flour and 60 g of sweet potato flour (T₆). Simultaneously, fungi were detected from the Vth month in T₅ (1×10^3 cfu g⁻¹) and VIth month in T₅ (2×10^3 cfu g⁻¹) of the storage studies. Even though bacteria and fungi were detected, they were present within the permissible limit. No coliforms could be detected in the developed GFCF cake mix flour. It must also be brought into the consideration that, among the samples analyzed, bacterial colonies and fungus was notable only in one sample randomly selected for analysis. So it could be concluded that, it might be due to cross contamination produced in any one lot of the GFCF cake mix flour prepared with sweet potato flour (T₅ and T₆) during the production.

However, GFCF cake mix flour prepared with banana flour was found to be sterile and free microbial contamination even after the 6th month of storage studies. The above findings prove that both GFCF cake mix flour prepared with banana flour and sweet potato flour are safe and stable up to a period of six months.

Conclusion

For the preparation of GFCF cake mix flour, the principle used was to remove all gluten and casein ingredients from the formulations. As gluten free casein free diet consists in completely removing those products which are the main source of gluten as well as those trace amounts. Then included malted sorghum flour as the main ingredient. The casein content in diet, the autistic children was unable to catabolize properly. So their diet should also eliminate casein which is the main protein ingredient of cow's milk and dairy products. To enhance the nutritional quality of cake mix flour includes red rice, raw banana flour, sweet potato flour and roasted bengal gram flour. From the study it was evident that a nutritionally rich gluten free casein free cake mix flour can be prepared without using the normal baking ingredients like refined flour, wheat flour and dairy products. The possibility of producing such novel formulations helps the daily life of parents and children with autism more comfortable and manageable.

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