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Kavitha Raj KN

Ph.D Scholar, Department of
Community Science, College of
Agriculture, Vellayani, Kerala
Agricultural University, Kerala,
India

Beela GK

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

Acceptability and parental perception of the developed gluten free casein free cake for children with autism spectrum disorder

Kavitha Raj KN and Beela GK

Abstract

There is growing interest in possible dietary involvement in the etiology and treatment of Autistic Spectrum Disorders (ASD). Although, the GFCF diet and its consequences and implications on the behavior of Autism Spectrum disorder needs more evidences. However, wide range of parents are adapting GFCF diet for their children. The purpose of this study was to study the acceptability and parental perception of the developed Gluten Free Casein Free cake or children with Autism spectrum disorder. In order to assess the acceptability of the developed GFCF cake, the parents were asked to prepare the cake by themselves and to give to their children. They were asked to respond to the BAMBIC scale to ascertain the eating behaviour and acceptability while introducing the developed GFCF cake. The result revealed that 56 percent of the children accepted the GFCF cake and consumed it completely and also 41 percent children accepted the cake and showed willingness to eat again. Although the GFCF diet are generally considered to be harmless, long-term administration it may cause micronutrient deficiencies. The cake developed in the present study overcomes this problem as it is rich in nutrients like protein, carbohydrate, dietary fibre, energy, vitamins and minerals. The present study has therefore successfully developed a GFCF cake which most parents reported high acceptability. The parents also reported that their children with ASD also accepted the cake.

Keywords: Adolescent, rural, urban, habits, attitudes, education

Introduction

Although, the GFCF diet and its consequences and implications on the behaviour of Autism Spectrum disorder needs more evidences. However, wide range of parents are adapting GFCF diet for their children. GFCF diet is one of the several alternative treatments for children with autism. When following this strict elimination diet, all foods containing gluten and casein are removed from the child's daily food intake. GFCF Cake was made with 140 g malted sorghum, 40 g banana flour and 20 g Bengal gram flour were selected as the best combination on the basis of its nutritional superiority. One of the paramount objectives is the acceptability evaluation of the cake by the children with ASD. Hence, the selected parents were given training along with cake demonstration. The cake prepared by the parents was given to the children for acceptability study.

Materials and Methods

Locale of the training and demonstration program

The locale of the study was at the Centre for Research and Development of Autistic Children (C.R.D.A.C) Urban Resource Centre, U R C, Aranattukara and BRC Kodakara, from Thrissur district.

Selection of sample

For the training cum demonstration, sample comprised of one hundreds of children with autism spectrum disorder symptoms, both boys and girls in the age group of 4-15 years. Selection of the sample was based on inclusion and exclusion criteria. The samples were selected with the help of a developmental therapist. The inclusion and exclusion criteria were as follows:

Corresponding Author:

Kavitha Raj KN

Ph.D Scholar, Department of
Community Science, College of
Agriculture, Vellayani, Kerala
Agricultural University, Kerala,
India

Inclusion criteria

- a) Any child in the age group of 4 to 15 years with a medical disability certificate with ASD
- b) Willingness to participate in the acceptability study

Exclusion criteria

- a) Children with ASD with gastrointestinal complications
- b) Unwillingness to participate in the study

Development of Tools for data collection

Success of every research study depends upon the use of appropriate and well-designed tools or techniques to elicit information from the sample and the following tools were used in the present study for assessment.

1. Demographic questionnaire for parents
Collecting details related to the demography of parents, which includes age, gender, educational status, religion, type of family, educational status, occupational status, family income and socio-economic status of the parents
2. Demographic questionnaire for children
Collecting details related to demographic characteristics of children, which includes age, gender, birth order, number of siblings, dietary pattern of children, frequency of consumption of GFCF diet of children with autism spectrum disorder.
3. Point hedonic scale organoleptic score card
4. BAMBIC scale
5. Observation schedule
An observation schedule was prepared to observe the participation index of parents

Organoleptic and acceptability study of the gfcfcake

The GFCF cake product prepared by mothers in the training was subjected to the organoleptic evaluation and acceptability study.

Organoleptic Evaluation

Organoleptic evaluation has an essential role in new products development with regard to its acceptability. The baked GFCF cakes were presented to mothers of the selected children with autism and compared it with a plum cake. They evaluated the sensory characteristics *viz*: colour, appearance, taste, texture, chewing ability and over all acceptability of both cakes on a score card using 5 point hedonic scale. The scores allotted were analyzed using statistical procedures to obtain a suitable conclusion.

Acceptability Study

The best scored cake made by mothers as per the organoleptic evaluation subjected to acceptability study among children with autism spectrum disorder. The mothers fed a piece of cake to the children and acceptability in a rating scaled score card (BAMBIC) filled by mothers based on the response of the children was obtained.

Brief Assessment of Mealtime Behaviour in Children (BAMBIC) which consists of 10 items. BAMBIC scale assesses three domains of mealtime behavior including food refusal, limited variety of food intake and disruptive mealtime behavior. The parent was asked to respond to each item of the scale using a 5 point scale ranging from always to never. The responses to each item were summed to yield a total score. Higher scores indicated more problem feeding behaviours.

Statistical Analysis

The data generated were analysed statistically using

appropriate methods. Sufficient replications were maintained for analysis. The data generated from the samples were subjected to Completely Randomized Design (CRD) analysis. In organoleptic analysis, the different preferences as indicated by scores were evaluated by Kruskal-wallis test to get the mean rank values for all the treatments.

Results**Demography of the participants**

Personal characteristics of the selected hundred parents of children with autism, such as age, gender, educational status, were assessed.

Distribution of parents according to age and gender

As summarized in the Table 1 hundred parents in the study who attended training program were classified age wise into three age groups. Thirteen percent of the parents in the Group I (20-39yrs) were males and 24 percent were females. Whereas in Group II (30-39yrs), sixty-three percent were males and sixty-six percent were females. Twenty-five percent males and ten percent of females came under the Group III (40-49yrs).

Table 1: Distribution of parents according to age and gender

Age group (years)	Males (No)	Females (No)	Total (No)
Group I (20-29)	1 (12.5)	22 (24.00)	23 (100)
Group II (30-39)	5 (62.5)	61 (66.00)	66 (100)
Group III (40-49)	2 (25.00)	9 (10.00)	11 (100)
Total	8 (100)	92 (100)	100

Values in parenthesis indicates percentage

Distribution of the respondents according to type and age of the family

Family can be divided into two types, namely nuclear and joint families. Based on the Table 2, the proportion of nuclear family system of subjects were 95.65 percent and 4.34 percent were in joint family system under the group I. 93 percent were in nuclear family and 12 percent were in joint family system under the Group II. In the case of Group III, 63 percent were of nuclear family and 36 percent were in the joint family system.

Table 2: Distribution of the respondents according to type and age of the family

Type of family	Group I (20-29) yrs.	Group II (30-39) yrs.	Group III (40-49) yrs.	Total
Nuclear	22 (95.65)	62 (93.00)	7 (63.00)	91 (100)
Joint	1 (4.34)	4 (12.00)	4 (36.00)	9 (100)
	23 (100)	66 (100)	11 (100)	100

Values in parenthesis indicates percentage

Educational status of the parents

Educational status of the parents when assessed it was seen to range from high school, plus two, under graduates and post graduates. The data revealed that 82 percent of the participants belonged to Group II had studied up to under graduate level, 6 percent had studied up to post graduate level and 12 percent had studied up to plus two level. In the case of group I, 82 percent had studied up to under graduate level and 17.39 percent had up to post graduated level. On the basis of data, 64 percent of participants belonged to the Group III had studied up to under graduate level, 27 percent had studied up to post graduate level and 9 percent had studied up to high school level.

Table 3: Educational status of the parents

Education	Group I (20-29) yrs.	Group II (30-39) yrs.	Group III (40-49) yrs.	Total
Post graduates	4 (17.39)	4 (6.06)	3 (27.00)	11 (100)
Under Graduates	19 (82.60)	54 (82.00)	7 (64.00)	80 (100)
Plus two	0	8 (12.00)	0	8 (100)
High school	0	0	1 (9.00)	1 (100)
Total	23 (100)	66 (100)	11 (100)	100

Values in parenthesis indicates percentage

Occupational status of the parents

Table 4 shows the occupational status of the parents. Regarding the occupational status of parents, it was seen that 48 percent were Government, 22 percent had private job, 30 percent had self-employed, no laborers and unemployed parents were in Group I. In the case of Group II, 48 percent had Government job, 32 percent had private job, and 20 percent were self-employees, no laborers and unemployed parents belonging to Group II. In the case of Group III, 45 percent had Government job, 27 percent of parents had private job, 18 percent of parents were self-employed, and 9 percent of them are laborers. No parents were unemployed in this group.

Table 4: Occupational status of the parents

Types of occupation	Group I (20-29) yrs.	Group II (30-39) yrs.	Group III (40-49) yrs.	Total
Government job	11 (48.00)	32 (48.00)	5 (45.00)	48(100)
Private job	5 (22.00)	21 (32.00)	3 (27.00)	29 (100)
Self employment	7 (30.00)	13 (20.00)	2 (18.00)	22 (100)
Laborers	0	0	1 (9.00)	1 (100)
Unemployed	0	0	0	0 (100)
Total	23 (100)	66 (100)	11 (100)	100

Values in parenthesis indicates percentage

Family income and socio-economic status of the parents

Table5 depicts the family income status of the parents. Results on the income level of parents belonging Group I reveals that majority of parents had the income between Rs. 2,73,167 to Rs. 8,45,955. In the case of Group II, 54.54 percent of parents had income in between Rs. 2,73,167 to Rs. 8,45,955. And Group III, 72.72 percent of parents had income in between Rs. 2,73,167 to Rs. 8,45,955. Among the three groups, majority of parents had income in between Rs. 2,73,167 to Rs. 8,45,955, which is in middle income family group category based on World Bank Country Classifications by Income Level 2020-21.

Table 5: Family income of the parents

Family income in Rupees	Group I (20-29) yrs.	Group II (30-39) yrs.	Group III (40-49) yrs.	Total
Below 70,000 Low income	1 (8.69)	1 (1.51)	1 (9.09)	3 (100)
70,137-2,73,098 Lower middle	6 (26.08)	25 (37.87)	2 (18.18)	33 (100)
2,73,167-8,45,955 Upper middle	14 (56.52)	39 (59.00)	8 (72.72)	61 (100)
Above 8,46,023 High income	2 (8.69)	1 (1.51)	0	3 (100)
Total	23 (100)	66 (100)	11 (100)	100

Values in parenthesis indicates percentage

In the present study, the parents were categorized as the lower class, upper lower class, lower middle class, upper middle class and upper-class families. The majority of the study's over all parents belonged to the upper middle-class family (50 percent) by adding each age group together. The percent of high-income family found to be very lower among all age groups of parents, particularly they were present in Group I (8.69 percent) and Group II (1.51 percent). Low income families was seen in all three groups.

Demographic characteristics of children with Autism Spectrum Disorder

Distribution of children with ASD according to age and gender

As summarized in the Table 6, the Group I was (4-6 yrs.) of age, there were 9 percent boys and 5 percent girls in this group. The Group II was (7-9) of age, there were 34 percent boys and 31 percent girls in this group. Whereas in Group II (10-12 yrs.) of age, there were 43 percent of boys and girls belonged in this group. In Group IV was (13-15 yrs.) of age, there were 15 percent boys and 21 percent in this group. Among these four age groups, it was evident that number of boys was higher than girls.

Table 6: Distribution of children according to age and gender

Age group (years)	Boys	Girls	Total
Group I (4-6)	4 (9.00)	2 (5.00)	6 (100)
Group II (7-9)	20 (34.00)	13 (31.00)	33 (100)
Group III (10-12)	25 (43.00)	18 (43.00)	43 (100)
Group IV (13-15)	9 (15.00)	9 (21.00)	18 (100)
Total	58 (100)	42 (100)	100

Values in parenthesis indicates percentage

Birth order of the children

Table 7 depicted that 67 percent of them were first born, 33 percent were second born and none of them were third born in Group I (4-6 yrs.). Group II was (7-9 yrs.) of age and there were 64 percent of them were first born, 36 percent were second born and none of them were born as third child. Whereas 49 percent of them were first born, 46percent were second born and 5 percent of them were third born in Group III (10-12yrs of age). In Group IV was (13-15) of age, 50 percent of them were first born, 27 percent were second born and 28 percent of them were third born.

Table 7: Birth order of the children

Age group (years)	I st child	II nd child	III rd child
Group I (4-6)	4 (67.00)	2 (33.00)	0
Group II (7-9)	21 (64.00)	12 (36.00)	0
Group III (10-12)	21 (49.00)	20 (46.00)	2 (5.00)
Group IV (13-15)	9 (50.00)	4 (27.00)	5 (28.00)
Total	55 (100)	38 (100)	7 (100)

Values in parenthesis indicates percentage

Dietary pattern of the children with Autism Spectrum Disorder

Food habits of children

Details of food habits furnished in the Table 8 indicates that more than 90 percent of the children were non-vegetarians and only 9 percent of the children were vegetarians.

Table 8: Food habits of children

Category	No of children
Vegetarian	9 (100)
Non vegetarian	91 (100)

Values in parenthesis indicates percentage

Awareness of the GFCF diet among the participants

As summarized in the Table 9, among the Group I, 78 percent of the parents in this training were aware and 22 percent of them were not aware about the GFCF diet. In the case of Group II, majority of the parents were aware about GFCF diet (70 percent) and 30 percent of the parents were not aware about GFCF diet. In Group III, 45 percent of the parents were aware and 55 percent of the parents were not aware about the GFCF diet. On the basis of this data, among the all three groups revealed that more than 60 percent of the participants were aware of the GFCF diet.

Table 9: Awareness of the GFCF diet among the participants

Participants	Age Group (yrs)	Total number	Aware	Not Aware
Parents	Group I 20-29	23	18 (78.00)	5 (22.00)
	Group II 30-39	66	46 (70.00)	20 (30.00)
	Group III 40-49	11	5 (45.00)	6 (55.00)
Total			69 (100)	31 (100)

Values in parenthesis indicates percentage

Frequency of consumption of GFCF foods

Table 10 depicted that in Group I, none of them were those who followed GFCF foods daily and weekly. While they followed the GFCF diet monthly, 50 percent children

followed the diet monthly once, 17 percent of the children followed the GFCF diet twice and thrice in a month and 17 percent of children, not at all followed the GFCF foods in their diet. In the case of Group II, 3 percent of the children were those who followed the GFCF diet daily. Six percent of the children were those who followed the GFCF diet thrice in a week and none of them were those who followed the GFCF diet on weekly basis. Monthly once, 3 percent of the children followed the GFCF diet, 9 percent children followed twice and thrice in a month and 69 percent children of Group II were not at all following the GFCF diet in their daily menu. In Group III, 12 percent children were those who followed the diet daily, 4 percent of them followed once, 2 percent of them followed twice and 7 percent of them followed GFCF diet thrice in a week. Monthly 19 of the children were those who followed the diet once, 5 percent of the children were those who followed the diet twice, 7 percent of the children followed the diet thrice and 44 percent children were those who not at all followed the GFCF diet in their daily life style. In Group IV, 11 percent children were those who followed the GFCF diet daily and also once in a week, one percent of the children followed the diet twice and thrice in a week. Monthly 22 percent children were those who followed the GFCF diet once, Five percent children followed the diet twice and thrice and 33 percent children not at all followed the diet.

Table 10: Frequency of consumption of GFCF foods

Age group (years)	Daily Following	Irregularly following						Not at all following
		Weekly			Monthly			
		Once	Twice	Thrice	Once	Twice	Thrice	
Group I (4-6)	0	0	0	0	3 (50.00)	1 (17.00)	1 (17.00)	1 (17.00)
Group II (7-9)	1 (3.03)	0	0	2 (6.00)	1 (3.00)	3 (9.00)	3 (9.00)	23 (70.00)
Group III (10-12)	5 (12.00)	2 (5.00)	1 (2.00)	3 (7.00)	8 (19.00)	2 (5.00)	3 (7.00)	19 (44.00)
Group IV (13-15)	2 (11.00)	2 (11.00)	1 (5.00)	1 (5.00)	4 (22.00)	1 (5.00)	1 (5.00)	6 (33.00)
Total	8 (100)	4	2	6	16	7	8	49 (100)
		12 (100)			31 (100)			

Values in parenthesis indicates percentage

Organoleptic Evaluation of GFCF Cake by mothers

The GFCF cake prepared by mothers were evaluated organoleptic ally for different quality attributes that was

suitable for children with ASD like color, appearance, taste, texture, chewing ability and overall acceptability.

Table 11: Organoleptic Evaluation of GFCF cake prepared by mothers

Variation	Appearance	Colour	Taste	Texture	Chewing ability	Overall acceptability
Control (Normal plum cake available in local market)	4.95	4.75	4.85	4.90	4.70	4.95
GFCF cake prepared by mothers	4.75	4.25	4.80	4.55	4.45	4.60
t value	1.70	2.93	0.36	2.33	2.33	2.66

Table 11 depicted that the GFCF cake prepared by mothers of children with autism spectrum disorder had reached maximum scores in all sensory qualities, when compared to a normal plum cake (control) available in local market. It was also found that GFCF cake was almost similar to that of the control sample. The GFCF cake had secured the highest taste (4.80) and appearance (4.75) compared to other quality

attributes. The mean score of taste and appearance was very nearer to the mean score of the control sample. The mean score of colour (4.25), texture (4.55) and chewing ability (4.45) were on par with the mean score of control sample.

Participation Index of parents

Table 12: Participation index of parents

Age group (years)	Attended Theory session	Attended practical session			Attended feedback session
		Flour mixing	Batter making	Baking	
Group I (20-29)23	23 (100.00)	23 (100.00)	23 (100.00)	22 (100.00)	23 (100.00)
Group II (30-39)66	66 (100.00)	61 (92.42)	61 (92.42)	61 (92.42)	66 (100.00)
Group III (40-49)11	11 (100.00)	9 (81.81)	9 (81.81)	10 (90.90)	8 (72.72)
Total	100	93	93	93	96

Values in parenthesis indicates percentage

Table 12 revealed that among the three groups, all the participants attended the theory session. In the case of practical session, above 90 percent of the parents participated in different sessions such as flour mixing, batter making and

baking of GFCF cakes. Ninety six percent of parents participated in feedback session too.

Acceptability of foods

Table 13: Parents Response to the GFCF Cake as per BAMBIC SCALE

BAMBIC Scale	Groups (yrs)	Never	Seldom	Occasionally	Often	Always
I. Acceptability						
A- Child accepts or prefers a variety of foods	G I (4-6) (yrs)	0 (0)	1 (17.00)	2 (33.00)	2 (33.00)	1 (17.00)
	G II (7-9) (yrs)	1 (3.00)	2 (6.00)	8 (24.00)	12 (36.00)	10 (30.00)
	G III (10-12) (yrs)	5 (12.00)	6 (14.00)	10 (23.00)	9 (21.00)	13 (30.00)
	G IV (13-15) (yrs)	0 (0)	0 (0)	0 (0)	0 (0)	18 (100.00)
Total		6	9	20	23	42
B- Child is willing to try new foods	G I (4-6) (yrs)	0 (0)	0 (0)	2 (33.00)	2 (33.00)	2 (33.00)
	G II (7-9) (yrs)	2 (6.00)	5 (15.00)	6 (18.00)	10 (30.00)	10 (30.00)
	G III (10-12) (yrs)	3 (7.00)	5 (12.00)	9 (21.00)	8 (19.00)	18 (42.00)
	G IV (13-15) (yrs)	1 (5.00)	1 (5.00)	1 (5.00)	0	15 (83.33)
Total		6	11	18	20	45
C- Child dislikes certain foods and won't eat them	G I (4-6) (yrs)	0 (0)	0 (0)	0 (0)	2 (33.00)	4 (67.00)
	G II (7-9) (yrs)	6 (18.00)	4 (12.00)	10 (30.00)	7 (21.00)	6 (18.00)
	G III (10-12) (yrs)	18 (42.00)	5 (12.00)	6 (14.00)	8 (19.00)	6 (14.00)
	G IV (13-15) (yrs)	14 (78.00)	1 (5.00)	1 (5.00)	1 (5.00)	1 (5.00)
Total		38	10	17	18	17
D-Child prefers the same foods at each meal	G I (4-6) (yrs)	0 (0)	0 (0)	1 (17.00)	3 (50.00)	2 (33.00)
	G II (7-9) (yrs)	11 (33.00)	10 (30.00)	7 (21.00)	2 (6.00)	3(9.00)
	G III (10-12) (yrs)	12 (28.00)	0 (0)	11 (25.00)	6 (18.00)	14 (32.00)
	G IV (13-15) (yrs)	13 (72.00)	1 (5.00)	1 (5.00)	2 (11.00)	1 (5.00)
Total		36	11	20	13	20
II. Food Refusal						
E- Child turns his/her face or body away from food	G I (4-6) (yrs)	1 (17.00)	1 (17.00)	1 (17.00)	2 (33.00)	1 (17.00)
	G II (7-9) (yrs)	7 (21.00)	7 (21.00)	9 (27.00)	5 (15.00)	5 (15.00)
	G III (10-12) (yrs)	31 (72.00)	1 (2.00)	10 (23.00)	0 (0)	1 (2.00)
	G IV (13-15) (yrs)	15 (83.00)	2 (11.00)	1 (5.00)	0 (0)	0 (0)
Total		54	11	21	7	7
F-Child closes his/her mouth tightly when food is presented	G I (4-6) (yrs)	0 (0)	0 (0)	1 (17.00)	4 (67.00)	1 (17.00)
	G II (7-9) (yrs)	9 (27.00)	3 (9.00)	10 (30.00)	7 (21.00)	4 (12.00)
	G III (10-12) (yrs)	30 (70.00)	1 (2.00)	8 (19.00)	2 (5.00)	2 (5.00)
	G IV (13-15) (yrs)	16 (89.00)	1 (5.00)	1 (5.00)	0 (0)	0 (0)
Total		55	5	20	13	7
G- Child cries or screams during mealtimes	G I (4-6) (yrs)	1 (17.00)	1 (17.00)	3 (50.00)	1 (17.00)	0 (0)
	G II (7-9) (yrs)	13 (39.00)	2 (6.00)	7 (21.00)	7 (21.00)	4 (12.00)
	G III (10-12) (yrs)	35 (81.00)	2 (5.00)	4 (9.00)	0 (0)	2 (5.00)
	G IV (13-15) (yrs)	18 (100.00)	0 (0)	0 (0)	0 (0)	0 (0)
Total		67	5	14	8	6
III. Food Disruptive Behavior						
H- Child is aggressive during mealtimes (e.g., hitting, kicking, scratching others)	G I (4-6) (yrs)	2 (33.00)	2 (33.00)	1 (17.00)	1 (17.00)	0 (0)
	G II (7-9) (yrs)	12 (36.00)	5 (15.00)	9 (27.00)	5 (15.00)	2 (6.00)
	G III (10-12) (yrs)	35 (81.00)	3 (7.00)	5 (12.00)	0 (0)	0 (0)
	G IV (13-15) (yrs)	18 (100.00)	0 (0)	0 (0)	0 (0)	0 (0)
Total		67	10	15	6	2
I-Child displays self-injurious behavior during mealtimes (e.g., hitting self, biting self)	G I (4-6) (yrs)	6 (100.00)	0 (0)	0 (0)	0 (0)	0 (0)
	G II (7-9) (yrs)	9 (27.00)	4 (12.00)	11 (33.00)	7 (21.00)	2 (6.00)
	G III (10-12) (yrs)	37 (86.00)	3 (7.00)	3 (7.00)	0 (0)	0 (0)
	G IV (13-15) (yrs)	18 (100.00)	0 (0)	0 (0)	0 (0)	0 (0)
Total		70	7	14	7	2
J- Child is disruptive during mealtimes	G I (4-6) (yrs)	3 (50.00)	0 (0)	2 (33.00)	1 (17.00)	0 (0)
	G II (7-9) (yrs)	9 (27.00)	8 (24.00)	10 (30.00)	2 (6.00)	4 (12.00)
	G III (10-12) (yrs)	37 (86.00)	2 (5.00)	4 (9.00)	0 (0)	0 (0)
	G IV (13-15) (yrs)	16 (89.00)	1 (5.00)	1 (5.00)	0 (0)	0 (0)
Total		65	11	17	3	4

Values in parenthesis indicates percentage

As per Table 13, general meal time behavior of the children with Autism Spectrum Disorder were analyzed and found that among the 6 children in Group I (4-6 yrs of age), none of them never accepted or preferred variety of foods in their general meal time pattern, 17 percent of them seldom accepted variety of foods, 33 percent of them accepted variety

of foods occasionally and often and 17 percent of them always accepted the variety of foods in their daily diet. Among 33 children in Group II (7-9 yrs of age), 3 percent of them never accepted or preferred variety of foods in their general meal time pattern, 6 percent of them seldom accepted variety of foods, 24 percent of them accepted variety of foods

occasionally, 36 percent of them often accepted or preferred variety of foods and 30 percent of them always accepted variety of foods in their daily diet. Among 43 children in Group III (10-12 yrs of age), 12 percent of them never accepted or preferred variety of foods in their general meal time pattern, 14 percent of them seldom accepted variety of foods, 23 percent of them accepted variety of foods occasionally, 21 percent of them often accepted or preferred variety of foods and 13 percent of them always accepted variety of foods in their daily diet. Among 18 children in Group IV (13-15 yrs of age), none of them were those who never, seldom, occasionally and often preferred or accepted variety of foods whereas 100 percent of them always accepted the variety of foods in their daily diet.

Among 6 children in Group I was (4-6 yrs of age), none of them were those who never and seldom willing to try new foods whereas, 33 percent of them were willing to try new foods occasionally, often and always in their daily diet. In the case of Group II (7-9 yrs of age) belonging 33 children, 6 percent of children were never willing to try new foods, 15 percent of them were seldom willing to try new foods, 18 percent of them were occasionally willing to try new foods and 30 percent of them were often and always willing to try new foods in their daily diet. Among 43 children in Group III (10-12 yrs of age), 7 percent of them were never willing to try new foods, 12 percent of them were seldom willing to try new foods whereas, 21 percent of them were occasionally willing to try new foods, 19 percent of them were often willing to try new foods and 42 percent of them were always willing to try new foods in their daily diet. Among 18 children in Group IV (13-15 yrs of age), 5 percent of them were those who never, seldom and occasionally willing to try new foods and none of them were often willing to try new foods, whereas 83 percent of the children were always willing to try new foods in their diet.

Among 6 children in Group I (4-6 yrs of age), none of them never, seldom and occasionally disliked certain foods and would not eat it, 33 percent of them often disliked certain foods and would not eat and 67 percent of them always disliked certain foods and would not eat that food in their daily diet. In the case of Group II (7-9 yrs of age) belonging to 33 children, 18 percent of them never disliked certain foods and would not eat it, 12 percent of them seldom disliked certain foods and would not eat it, 30 percent of them occasionally disliked certain foods and would not eat it, 21 percent of them often disliked certain foods and would not eat and 18 percent of them always disliked certain foods and would not eat that food in their daily diet. Among 43 children in Group III (10-12 yrs of age), 42 percent of them never disliked certain foods and would not eat it, 12 percent of them seldom disliked certain foods and would not eat it, 14 percent of them occasionally disliked certain foods and would not eat it, 19 percent of them often disliked certain foods and would not eat and 14 percent of them always disliked certain foods and would not eat that food in their daily diet. Among 18 children in Group IV (13-15 yrs of age), 78 percent of them never disliked certain foods and would not eat it, 5 percent of them seldom, occasionally, often and always disliked certain foods and would not eat that food in their daily diet.

Among 6 children in Group I (4-6 yrs of age), none of them never and seldom preferred the same foods at each meal, whereas 17 percent of them occasionally preferred the same foods at each meal, 50 percent of them often preferred the same foods at each meal and 33 percent of them always preferred the same foods at each meal. In the case of Group II

(7-9 yrs of age) belonging to 33 children, 33 percent of them never preferred the same foods at each meal, whereas 30 percent of them seldom preferred the same foods at each meal, 21 percent of them occasionally preferred the same foods at each meal, 6 percent of them often preferred the same foods at each meal and 9 percent of them always preferred the same foods at each meal. Among 43 children in Group III (10-12 yrs of age), 28 percent of them never preferred the same foods at each meal, whereas none of them seldom preferred the same foods at each meal, 25 percent of them occasionally preferred the same foods at each meal, 18 percent of them often preferred the same foods at each meal and 32 percent of them always preferred the same foods at each meal. Among 18 children in Group IV was of age (13-15 yrs of age), 72 percent of them never preferred the same foods at each meal, whereas 5 percent of them seldom, occasionally and always preferred the same foods at each meal and 11 percent of them often preferred the same foods at each meal.

Food refusal behavior of children with Autism Spectrum Disorder

As per the table 13, general food refusal behavior of the children with ASD was analyzed using BAMBIC scale. Among 6 children in Group I(4-6 yrs of age), 17 percent of them never, seldom and Occasionally turned his/her face or body away from food. Whereas 33 percent of them often turned his/her face or body away from food and 17 percent of them always turned his/her face or body away from food. In the case of Group II (7-9 yrs of age) belonging to 33 children, 21 percent of them never and seldom turned his /her face or body away from food, 27 percent of them occasionally turned his /her face or body away from food, 18 percent of them often turned his /her face or body away from food. Among 43 children in Group III (10-12 yrs of age), 72 percent of them never turned his /her face or body away from food, 2 percent of them seldom turned his /her face or body away from food, 23 percent of them occasionally turned his /her face or body away from food, none of them often turned his /her face or body away from food and 2 percent of them always turned his /her face or body away from food. Among 18 children in Group IV (13-15 yrs of age), 83 percent of them never turned his /her face or body away from food, 11 percent of them seldom turned his /her face or body away from food, 5 percent of them occasionally turned his /her face or body away from food and none of them turned his /her face or body away from food often and always.

Among 6 children in Group I (4-6 yrs of age), none of them never and seldom closes his/her mouth tightly when the food is presented, whereas 17 percent of them occasionally closes his/her mouth tightly when the food is presented, 67 percent of them often closes his/her mouth tightly when the food is presented and 17 percent of them always closes his/her mouth tightly when the food is presented. In the case of Group II (7-9 yrs of age) belonging to 33 children, 27 percent of them never closes his/her mouth tightly when the food is presented, 9 percent of them seldom closes his/her mouth tightly when the food is presented, 30 percent of them occasionally closes his/her mouth tightly when the food is presented, 21 percent of them often closes his/her mouth tightly when the food is presented and 12 percent of them always closes his/her mouth tightly when the food is presented. Among 43 children in Group III (10-12 yrs of age), 70 percent of them never closes his/her mouth tightly when the food is presented, 2 percent of them seldom closes his/her mouth tightly when the food is presented, 19 percent of them occasionally closes his/her

mouth tightly when the food is presented and 5 percent of them often and always closes his/her mouth tightly when the food is presented. Among 18 children in Group IV was of age (13-15 yrs of age), 89 percent of them never closes his/her mouth tightly when the food is presented, 5 percent of them seldom and occasionally closes his/her mouth tightly when the food is presented and none of them closes his/her mouth tightly when the food is presented often and always. Among 6 children in Group I (4-6 yrs of age), 17 percent of them never and seldom cried or screamed during meal time. Whereas 50 percent of them occasionally cried or screamed during meal time, 17 percent of them often cried or screamed during meal time and none of them always cried or screamed during meal time. In the case of Group II (7-9 yrs of age) belonging to 33 children, 39 percent of them never cried or screamed during meal time, 6 percent of them seldom cried or screamed during meal time, 21 percent of them occasionally and often cried or screamed during meal time and 12 percent of them always cried or screamed during meal time. Among 43 children in Group III (10-12 yrs of age), 81 percent of them never cried or screamed during meal time, 5 percent of them seldom cried or screamed during meal time, 9 percent of them occasionally cried or screamed during meal time, none of them often cried or screamed during meal time and 5 percent of them always cried or screamed during meal time. Among 18 children in Group IV was of age (13-15 yrs of age), 100 percent of them never cried or screamed during meal time.

Disruptive behavior of children with ASD during meal time

As per the table 13, general disruptive behavior of the children with ASD during mealtime was analyzed using BAMBIC scale. Among 6 children in Group I (4-6 yrs of age), 33 percent of them were never and seldom aggressive during the mealtime. Whereas 17 percent of them were occasionally and often aggressive during the mealtime, and none of them were always aggressive during the mealtime. In the case of Group II (7-9 yrs of age) belonging to 33 children, 36 percent of them were never aggressive during the mealtime, 15 percent of them were seldom and often aggressive during the mealtime, whereas 27 percent of them were occasionally aggressive during the mealtime and 6 percent of them were always aggressive during the mealtime. Among 43 children in Group III (10-12 yrs of age), 81 percent of them were never aggressive during the mealtime, 7 percent of them were seldom aggressive during the mealtime, 12 percent of them were occasionally aggressive during the mealtime and none of them were aggressive during the mealtime often and always. Among 18 children in Group IV age (13-15 yrs of age), 100 percent of them were never aggressive during the mealtime.

Among 6 children in Group I (4-6 yrs of age), 100 percent of them never displayed self-injurious behavior during mealtime. In the case of Group II (7-9 yrs of age) belonging to 33 children, 27 percent of them never displayed self-injurious behavior during mealtime, 12 percent of them seldom displayed self-injurious behavior during mealtime, 33 percent of them occasionally displayed self-injurious behavior during mealtime, 7 percent of them often displayed self-injurious

behavior during mealtime and 2 percent of them always displayed self-injurious behavior during mealtime. Among 43 children in Group III (10-12 yrs of age), 86 percent of them never displayed self-injurious behavior during mealtime, 7 percent of them seldom and occasionally displayed self-injurious behavior during mealtime and none of them displayed self-injurious behavior during mealtime often and always. Among 18 children in Group IV (13-15 yrs of age), 100 percent of them never displayed self-injurious behavior during mealtime.

Among 6 children in Group I (4-6 yrs of age), 50 percent of them never had disruptive behavior during mealtime, whereas none of them had seldom disruptive behavior during mealtime, 33 percent of them had occasionally disruptive behavior during mealtime, 1 percent of them had disruptive behavior during mealtime often and none of them had disruptive behavior during mealtime always. In the case of Group II (7-9 yrs of age) belonging to 33 children, 27 percent of them had no disruptive behavior during mealtime, 24 percent had seldom disruptive behavior during mealtime, 30 percent had occasionally disruptive behavior during mealtime, 6 percent of them had disruptive behavior during mealtime often and 12 percent of them always had disruptive behavior during mealtime. Among 43 children in Group III (10-12 yrs of age), 86 percent of them never had disruptive behavior during mealtime always, 5 percent of them had seldom disruptive behavior during mealtime always, 9 percent of them had occasionally disruptive behavior during mealtime always and none of them had disruptive behavior during mealtime often and always. Among 18 children in Group IV (13-15 yrs of age), 89 percent of them never had disruptive behavior during mealtime, 5 percent of them seldom and occasionally had disruptive behavior during mealtime and none of them had disruptive behavior during mealtime often and always.

Behaviour of children with ASD when the cake is introduced

(Adapted from BAMBIC scale)

Among 6 children in Group I (4-6 yrs of age), 50 percent of the children accepted cake and had it all completely whereas 33 percent of them asked for more cake. None of them left the cake piece or bite and spat the cake. In the case of Group II (7-9 yrs of age) belonging to 33 children, 45 percent of the children accepted cake and had it all completely whereas 48 percent of them asked for more cake. None of them left the cake piece or bite and spat the cake. Among 43 children in Group III (10-12 yrs of age), 65 percent of the children accepted cake and had it all completely whereas 35 percent of them asked for more cake. None of them left the cake piece or bite and spat the cake. Among 18 children in Group IV (13-15 yrs of age), 55 percent of the children accepted cake and had it all completely whereas 44 percent of them asked for more cake. None of them left the cake piece or bite and spat the cake. In the case of food refusal, among the all age groups 17 percent of them in group I and 6 percent of them from Group II disliked the. In Group III and IV, none of them had refused the cake. And none of them had showed any disruptive behavior among all the age groups of children with Autism Spectrum Disorder.

Table 14: Behaviour of children with ASD when the cake is introduced (Adapted from BAMBIC scale)

BAMBIC scale	Acceptability			Food Refusal				Disruptive behavior				
	A	B	C	D	E	F	G	H	I	J	K	L
G I(4-6 yrs)	3 (50.00)	0	0	2 (33.00)	0	0	0	1 (17.00)	0	0	0	0
G II (7-9)	15 (45.00)	0	0	16 (33.00)	0	0	0	2 (6.00)	0	0	0	0
G III (10-12)	28 (65.00)	0	0	15 (35.00)	0	0	0	0	0	0	0	0
G IV (13-15)	10 (55.00)	0	0	8 (35.00)	0	0	0	0	0	0	0	0
Total (n=100)	56 (100)	0	0	41 (100)	0	0	0	3 (100)	0	0	0	0

Values in parenthesis indicates percentage

- A- Child accepted the cake and had it all completely
- B- Child accepted the cake but had only a portion,
- C- Child accepted the cake but had a bite and spat,
- D- Child asked for more cake,
- E- Child turned his/her face or body away from cake.
- F- Child closed his/her mouth tightly when cake was presented,
- G- Child cried or screamed when the cake was presented,
- H- Child dislikes certain foods and won't eat them so is the case of cake,
- I- Child was aggressive when cake was introduced (e.g., hitting, kicking, scratching others)
- J- Child displayed self-injurious behavior when cake was introduced(e.g., hitting self, biting self),
- K- Child was disruptive when the cake was introduced (e.g., pushing/throwing utensils, food),
- L- Child threw away the cake when introduced to him

Discussion

Dietary pattern of the children with Autism Spectrum Disorder

Assessment of the dietary pattern of an individual is an emerging area of research. It is defined as the consumption pattern of foods and beverages in terms of quantity.

Food habits of the children with ASD were categorized into two groups, vegetarians and non-vegetarians. In this study, majority of children with autism in the study population were non vegetarian (91 percent) and only nine percent children were on vegetarian diet. Based on the eating habits of children with autism, majority of them were found to be selective against some foods and the most omitted food group is vegetables (Ranjan and Nasser, 2015) [23].

The present study observed that majority of children had the habit of taking biscuits and tea (56 percent) after getting up from bed. The intake of chocolate (41 percent) was also higher, among all groups of children with Autism spectrum disorder. Around 79 percent of the children consume ice creams occasionally. Daily intake of chips and fries (41 percent) especially 'lays' and 'kurkure' were also noticed in this study. Junk foods such as carbonated drinks (67 percent), burger (77 percent), Pizza (58 percent) and cakes (65 percent) were consumed occasionally. Around 57 percent of children consumed noodles and sandwich (31 percent) daily. Children with autism spectrum disorder consumed larger amounts of foods such as pasta, pizza, pastries, biscuits, chocolates and overall energy dense foods. This revealed that children with autism showed a preference for sweet taste and savory foods, consequently tending to an excessive consumption (Schreck *et al.*, 2014) [26].

Participation index of parents revealed that hundred percent of the parents attended the theory session, for the practical session 93 percent of them were participated and 96 percent of the parents of children with autism attended the feedback session. Since the training was conducted in an interesting and participatory manner. Majority of the parents involved in

theory session, practical session such as GFCF flour mixing, batter, making, baking of cake and feedback session. However, some parents participate the training program partially because of age factor or due to physical fatigue. The findings of the study revealed that parents participated in the training program whole heartedly and also benefitted from the sessions, demonstrations and discussion. The result of this study demonstrated that the GFCF cake training was useful as an introductory program for parents who experience differently with regard to selective eating in their children and to incorporate GFCF cake in their diet.

Among hundred participants in the training, 78 percent of the parents in this training were aware and 22 percent of them were not aware about the GFCF diet. In the case of Group II(30-39 yrs), majority of the parents were aware about GFCF diet (70 percent) and 30 percent of the parents were not aware about GFCF diet. In Group III, 45 percent of the parents were aware and 55 percent of the parents were not aware about the GFCF diet. On the basis of this data, among the all three groups revealed that more than 60 percent of the participants were aware of the GFCF diet. Several studies underlined that many parents of children with ASD has turned to an alternative treatments including elimination diet such as gluten free casein free diet, which was more safe and feasible than other alternative treatments (Bandini *et al.*, 2010; Cade *et al.*, 2000; Hanson *et al.*, 2007; Perrin *et al.*, 2012 and Sharp *et al.*, 2013) [2, 5, 9, 21, 30].

Result of overall frequency of consumption of GFCF foods showed that, 8 percent children were following the GFCF diet daily in their menu. 4 percent children were following the diet once, 2 percent children were following the diet twice and 6 percent children were following the diet thrice in a week. While 16 percent children were following the GFCF diet once, 7 percent children were following the diet twice and 8 percent children were following the diet thrice in a month. About 49 percent children were not at all following the GFCF diet as their life style. Several studies show that GFCF diets were very popular among the families who had children with autism (Baspinar and Yardimci, 2020; Haleem and Hafez, 2015; Sanctuary *et al.*, 2018) [3, 8, 25]. However not many were following the GFCF diet regularly or daily basis.

Though the parents are aware of GFCF diet and its consequences, inclusion of GFCF diet on a daily basis is becoming impractical. It can also be because there are not many GFCF products available in the local markets.

Organoleptic and acceptability study of the cake prepared by mothers of children with autism spectrum disorder

The GFCF cake prepared out of the formulated GFCF cake mix flour was subjected to an acceptability test by mothers of children with Autism Spectrum Disorder. The GFCF cake was compared with a plum cake available at local market. The mean scores of five variations of GFCF cake and control sample (plum cake available in local market) in appearance, colour, taste, texture, chewing ability and overall acceptability

were assessed and a comparison study was carried out. GFCF cake prepared by mothers of children with autism spectrum disorder had reached maximum scores in all sensory qualities, and also it was almost similar to that of the control sample (plum cake). The GFCF cake had secured the highest score for taste (4.80) and appearance (4.75) compared to other quality attributes. The mean score of taste and appearance was very nearer to the mean score of the control sample. The mean score of colour (4.25), texture (4.55) and chewing ability (4.45) were maximum in GFCF cake due to the combination of ingredients, namely malted sorghum, banana flour and bengal gram flour, since these ingredients gave the coarse structure. The taste and appearance of the GFCF cake was enhanced due to the addition of dry fruits and nuts.

It was observed during sensory evaluation that all the quality attributes of GFCF cake prepared by mothers of children with autism was liked extremely, and they were highly appreciated when compared to the control sample (plum cake). Moreover, GFCF cakes prepared by mothers had reached the maximum score (4.60) compared to control sample (4.95) in overall acceptability. The selection of ingredients for the preparation of GFCF cake mix in the present study is par on the study of many researches (Haleem and Hafez, 2015; Hussein *et al.* 2012; Ronda *et al.* 2009 and Segundo *et al.* 2020) [8, 11, 24, 27]. Several other studies have observed that cake from sorghum showed acceptance (Adhikari and Acharya, 2015; Karki *et al.*, 2016; Kim *et al.*, 2011) [1, 13, 14]. Similarly cake made from bengal gram flour and raw banana powder also showed acceptance (Gadallah, 2017; Turker *et al.*, 2016) [7, 31]. The high acceptance in this study for cake might be due to the appropriateness of ingredients for the specific type of GFCF cake being made, a properly balanced formula and the optimum mixing and baking process.

Most parents reported high acceptability to GFCF cake and this is possibly because the parents understood the factors of food preferences for ASD which was addressed in the training. This result is a direct consequence of the improved communication among the parents in small groups which enabled the parents to become familiar with the various factors underlying in the preparation of GFCF cake. In spite of the short period of the training, the interventions not only improved the parent's subjective view towards GFCF diet but also were consumed in preparing GFCF cake.

The group dynamics motivated the parents and allowed them to prepare GFCF cake with confidence.

General eating behavior of children with ASD using BAMBIC scale

With the help of BAMBIC scale general mealtime behavior of the children with autism was analyzed. The result revealed that majority of the children in this study always accepted variety of foods (42 percent) and willing to try new foods (45 percent) in their diet. Similar results have shown in other studies (Malhi *et al.*, 2020; Sena and Bayhan, 2019) [15, 29]. Moreover, 38 percent of the children never disliked certain foods and prefer the same food at each meal (36 percent).

In the present study majority of children never showed any food refusal behaviour, 54 percent of the children never turn his/her face or body away from food, 55 percent never closed his/her mouth tightly when food is presented and 67 percent children never cries or screams during mealtime. It was observed that majority of the children who showed food refusal behaviour belonged to Group I (4-6) and Group II (7-9). The food refusal sub scale reveals the refusal behaviours of the child at a mealtime (Hendy *et al.*, 2013) [10]. Such

behaviours are behaviors to avoid eating foods such as keeping its mouth close tightly, food discard, crying, anger etc. (DeMoor *et al.*, 2007) [6]. According to the findings, this condition was found to occur in children with ASD. Some other studies showed that children with ASD have eating rejection due to food selectivity (Hendy *et al.*, 2013; Meral and Fidan, 2014) [10, 18]. Similarly, study conducted by Hendy *et al.* (2013) [10] determined that younger age group has more food refusal

The result revealed that in the present study, majority of the children with autism never showed any disruptive behaviour, 67 percent of the children never showed any aggressiveness during mealtime, 70 percent never displayed self-injurious behaviour during mealtime and 65 percent never showed any disruptive behaviour during mealtime. Among the children with all age groups, younger children showed some disruptive behaviour. In the present study, children belonged to the age group of Group I (4 to 6) and Group II (7 to 9) showed disruptive behaviour. Similar study was observed using BAMBIC scale and found that 3 years old children with autism have more food refusal and disruptive behaviour 4 years old children, that is age advances, refusal and disruptive behaviour decreases (Seiverling *et al.*, 2014; Yilmaz *et al.*, 2011) [10, 32].

When the children with ASD are enrolled in an institution their behaviour is modified (Hyman *et al.*, 2020) [12]. The behaviour therapy and other intervention programs imparted at the institution could be the reason for the increasing acceptances and the absence of feeding or eating behaviour on the present study.

Several studies have shown the efficacy of interventions to improve feeding difficulties in children with ASD (Marshall *et al.*, 2013; Miyajima *et al.*, 2017) [17, 19].

Acceptability of the GFCF cakes when introduced to children with autism (Adapted from BAMBIC scale)

Among all the age groups, 56 percent children accepted the GFCF cake and consumed it completely and also 41 percent children accepted the cake and showed willingness to eat again. From this observation, among 100 children 97 percent of children highly accepted the cake. Only 3 percent of them had refused the cake. It may be because the children with ASD dislike certain foods and would not eat them. Similar reports by Cermak *et al.*, 2010 [4]; Margari *et al.*, 2020 [16]; Nathe, 2014 [20] and Rastam, 2008 [22] also reported that children with ASD were often described as picky or selective eaters.

The GFCF cake made by malted sorghum, banana flour and roasted bengal gram was highly accepted by the children with autism. It may be because of the amount of sugar (170 g) and the sweetness of the cake the children accepted it. According to Schreck *et al.* (2014) [26] observed that children with autism showed a preference for sweet taste. The proportion of the GFCF flour, sugar and egg white was 3:1:2. And that could be the reason for acceptance.

Also the appearance, color and flavor of the cake were highly accepted by the children with autism. The color of the cake which was golden brown was highly appealing. The cake was decorated with dry fruits and nuts which made the children to accept and did not deny or reject it. Similar study by Haleem and Hafez (2015) [8] with a cake was developed from corn flour, carrot flour and rice flour, the children with autism had exhibited huge acceptance and willingness to eat the cake.

Summary and Conclusion

A GFCF Cake was made with 140 g malted sorghum, 40 g

banana flour and 20 g Bengal gram flour were selected as the best combination on the basis of its nutritional superiority. In order to assess the acceptability of the developed GFCF cake, the parents were asked to prepare the cake by themselves and to give to their children. They were asked to respond to the BAMBIC scale to ascertain the eating behaviour and acceptability while introducing the developed GFCF cake. The result revealed the children accepted the GFCF cake and consumed it completely and also 41 percent children accepted the cake and showed willingness to eat again. It also observed that 97 percent of children highly accepted the cake. It could be concluded that the results developed a GFCF cake which most parents reported high acceptability. The parents also reported that their children with ASD also accepted the cake. The present developed GFCF cake will to a boon for the children with ASD and they can frequently enjoy a nutritious cake like other children.

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