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ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICE ABOUT SORGHUM AS A GLUTEN FREE CEREAL

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Abstract

Celiac disease is affecting the health and nutritional status of the general population. It is aggravated by using gluten containing food in diet. Prominent gluten free substitutes available in the market are rice, and corn but they can cause inflammation in gut. This study focuses on the assessment of knowledge, attitude, and practices of using sorghum as gluten free cereal from the university and college students of Pakistan. Primary data was collected from the students using a snowball sampling technique. A sample size of 250 was used and a questionnaire was developed for data collection. Data was analysed using SPSS version 21.0 and Pearson chi square test was applied to all the variables to find out the association. Results showed that about half of the population who have the knowledge of celiac disease had the knowledge about gluten free nature of sorghum and its use for their treatment. Among people who have the family history of celiac disease some did not have the knowledge about sorghum. Half of the population either did not know or thinks that sorghum is only available in supermarkets. Out of this half population only 32% knew about the price of sorghum but 47% of population still knew its use to make other food products. Among people having the knowledge of food and nutrition 28% population also did not know about gluten free nature of sorghum. The findings suggest that most of the student population did not have adequate knowledge about sorghum, its availability, and its use in Pakistan.

Keywords

Sorghum, Gluten free Substitute, Pakistan, Celiac Disease, Students, Cheap Cereal, Knowledge.

1. Introduction

Gluten consumption in diet has been one of the most rising concerns that is affecting the nutritional status and general well-being of people of all ages (Siminiuc & Țurcanu, 2020). Over the years, the processing of wheat grain has changed drastically to meet the increased food supply. This change in processing of wheat has caused many people to develop gluten related disorders. Foods containing gluten are affecting people with autoimmune diseases like Celiac disease. This disease is highly triggered by the intake of gluten in diet and can cause symptoms like fatigue, iron deficiency, psychological disorders, anaemia, or depression. Celiac disease is a major food intolerant disease that is becoming a prevalent gastrointestinal disorder in all over the world. This disease can result from a number of environmental factors like changes in gut microbial flora or certain kind of gastrointestinal infection but it can only be prevented by following a gluten free diet (Itzlinger, 2018). Healthy gluten substitutes are limited in many countries. Gluten free options available in market are corn, millet, quinoa, oat, and rice. Rice and corn are most commonly used but they can trigger inflammation in the gut which could further lead to malnutrition. Sorghum is another gluten free cereal available in market but there are certain characteristics of Sorghum such as its ability to survive in dry and hot climate; its outstanding nutritional profile which makes it the most desirable gluten substitute present in the food industry. Sorghum is a nutrient-rich grain that has shown exceptionally positive results in treating patients with celiac disease and other gluten related disorders due to its gluten-free nature. Sorghum is a major cereal crop that is gluten-free, grown in Pakistan and has therapeutic benefits regarding the gut health (Samasca, 2016). Various studies have revealed that sorghum is safe for celiac patients by studying its genome and chemical properties. Its high nutritional and functional properties in accordance with other gluten free products makes it superior to other flours. Sorghum is rich in antioxidants like flavonoids, phenolic acids, and tannins. These antioxidants have shown to reduce the oxidative stress and inflammation in the human body. Sorghum is also an excellent source of protein and provides with as much protein as the quinoa grain, which is known for its high protein content. It has a great fatty acid profile containing both linoleic acid and oleic acid. It also contains high prolamin content due which it is hard compared to other cereal (Pontieri *et al.*, 2013) (Rai *et al.*, 2018) (Pineli, 2015). Research has also showed that many countries have been using this underrated cereal grain, sorghum as a gluten substitute. Some of the food products that have been developed using sorghum in countries such as India and West Africa are tortillas, roti, different kinds of bread and infant formula. many types of porridges and upma. The sensory and nutritional profiles of these developed products have been quite impressive which further makes sorghum a desirable gluten substitute. The anti-nutritional factors present in the sorghum can be minimized by using lactic acid bacteria fermentation. It was also revealed that addition of various additives and products like gums, xanthan gum, carboxy methyl cellulose, egg, and skimmed milk powder were required for better texture and consumer acceptability of such products (Chávez, 2018) (Adiamo *et al.*, 2018). It was proved through experiments performed in preliminary laboratories that, a good sorghum bread can be made with the help of 30% sorghum and corn starch without adding any additional components or ingredients. In that regard the product of sorghum bread with the simplest recipe in which no additional ingredients were added, in

developing countries ultimately reduces the cost and so people with low socioeconomic status suffering from celiac disease can purchase the gluten free products without any difficulty. Different genotypes of sorghum give different degree of elasticity in starch and hence can be used to produce different varieties of noodles (Adiamo *et al.*, 2018). According to the available literature prevalence of celiac sprue will continue to increase with the coming years in both developing and developed countries. So, there is a need to raise awareness about best gluten free substitutes that can be used in developing countries like Pakistan where there is less awareness and availability of gluten free products. This study focuses on the assessment of knowledge, attitude, and practices about the use of sorghum as a gluten free cereal in college and university students of developing country like Pakistan.

2.Materials and Methods

The aim of this study was to assess the knowledge, attitude, and practices about the use of sorghum as a gluten free cereal among students. The target population comprised of college and university students. Primary data was collected using snowball sampling technique. Data was collected by developing a self-structured questionnaire and administrating it. The questionnaire comprised of various question related to celiac disease, sorghum, its availability and use. A pilot study was conducted, and the questionnaire was pre-tested on a sample of college and university students, who were randomly selected for the study. It was done in an order to check appropriateness of the questionnaire and to assess that whether the population was able to understand the questionnaire easily. However, the results and respondents of that pilot study were not included in the present study. The purpose of pre-testing was to determine the appropriateness of the designed questionnaire for the target population. The data for the current study was collected from 250 respondents using snowball sampling design. The reliability of the results was checked using Cronbach's Alpha test and the value of the test was 0.63 which is close to 0.7 and is acceptable. Data was analyzed using chi-square test whereas in descriptive statistics; frequencies and the percentages were also calculated. The analysis of data was done using SPSS 21.0 version. It is observed from table 1 that out of 250 participants, 70.4% fall in the category of the age group 18- 24 years, 22.8% are in the category of the age group 25-31 years and only 6.8% are in the category of age group 32-38 years. 23.6% of the participants are college students, 47.6% are graduates while the remaining 29.2% are postgraduates. 30% of the participants strongly agreed that they had knowledge about food and nutrition while 55.6% agreed that they had knowledge about food and nutrition. 12% said that they did not have much knowledge about food and nutrition. Only 2% and 0.4% disagreed and strongly disagreed respectively with the statement that they had knowledge about food and nutrition. 25.2% of the participants strongly agreed that they had knowledge about celiac disease while 45.2% agreed that they had knowledge about celiac disease. 24% said that they did know about celiac disease. Only 5.2% and 0.4% disagreed and strongly disagreed respectively with the statement that they had knowledge about celiac disease. 8.8% of the participants strongly agreed that they have people in their family suffering from celiac disease while 16% agreed that have people in their family suffering from celiac disease. 26.4% said that they did know if someone in their family has celiac disease.

Table 1: Table of Frequency Distribution

Variable	Sub Variable	Frequency	Percentage (%)
Age Group	18-24 years	176	70.4
	25-31 years	57	22.8
	32-38 years	17	6.8
Education	College student	59	23.6
	Graduate	118	47.2
	Postgraduate	73	29.2
Knowledge about food and nutrition	Strongly agree	75	30.0
	Agree	139	55.6
	Do not know	30	12.0
	Disagree	5	2.0
	Strongly disagree	1	0.4
Knowledge about celiac disease	Strongly agree	63	25.2
	Agree	113	45.2
	Do not know	60	24.0
	Disagree	13	5.2
	Strongly disagree	1	0.4
Family history	Strongly agree	22	8.8
	Agree	40	16.0
	Do not know	66	26.4
	Disagree	64	25.6
	Strongly disagree	58	23.2
Do they follow a specific diet	Strongly agree	32	12.8
	Agree	84	33.6
	Do not know	72	28.8
	Disagree	45	18.0
	Strongly agree	32	12.8
	Carbohydrate free	23	9.2
	Sugar free diet	16	6.4
If yes, then which diet is followed	Gluten free diet	121	48.4

What is gluten	Sodium free diet	6	2.4
	Fat free diet	5	2.0
	None	79	31.6
	A protein in wheat	140	56.0
	A protein in all carbohydrates	25	10.0
	Something related to wheat	48	19.2
	Do not know	37	14.8
There are strict restrictions in celiac disease	Strongly agree	34	13.6
	Agree	101	40.4
	Do not know	69	27.6
	Disagree	40	16.0
	Strongly disagree	6	2.4
Gluten free products are available only in supermarket	Strongly agree	32	12.8
	Agree	103	41.2
	Do not know	72	28.8
	Disagree	35	14.0
	Strongly disagree	8	3.2
Only rice, corn and millet are wheat substitute	Strongly agree	25	10.0
	Agree	80	32.0
	Do not know	56	22.4
	Disagree	74	29.6
	Strongly disagree	15	6.0
Sorghum is a natural gluten free cereal	Strongly agree	49	19.6
	Agree	96	38.4
	Do not know	93	37.2
	Disagree	10	4.0
	Strongly disagree	2	0.8
Sorghum can be used for celiac patients	Strongly agree	32	12.8
	Agree	115	46.0
	Do not know	95	38.0
	Disagree	7	2.8
	Strongly disagree	1	0.4
Sorghum is only available in supermarket	Strongly agree	21	8.4
	Agree	76	30.4

	Do not know	106	42.4
	Disagree	40	16.0
	Strongly disagree	7	2.8
	Strongly agree	20	8.0
Sorghum is cheap cereal in Pakistan	Agree	80	32.0
	Do not know	123	49.2
	Disagree	23	9.2
	Strongly disagree	4	1.6
	Strongly agree	24	9.6
Sorghum flour can be used to make chapatti	Agree	117	46.8
	Do not know	91	36.4
	Disagree	15	6.0
	Strongly disagree	3	1.2
	Strongly agree	30	12.0
Sorghum flour can be used for making biscuits, pasta, and noodles	Agree	114	45.6
	Do not know	95	38.0
	Disagree	10	4.0
	Strongly disagree	1	0.4

25.6% and 23.2% disagreed and strongly disagreed respectively with the statement that they had people in their family suffering from celiac disease. Out of the participants who said that there were people in their family suffering from celiac disease, 48.4% said that they knew that gluten free diet is followed by celiac patients while 31.6% said that there are no dietary restrictions followed by celiac patients. 9.2% and 6.1% said that celiac patients follow carbohydrate free and sugar free diet, respectively. 2.4% and 2% said that celiac patients follow sodium free and fat free diet, respectively. Out of the total participants, 56% knew that gluten is a protein in wheat while 19.2% did not exactly knew about gluten but knew that it is something related to wheat and 14.8% said they did not know what gluten is. Only 10% said that gluten is a protein in all carbohydrates. 12.8% of the participants strongly agreed that gluten free products are only available in supermarkets while 41.2% agreed that gluten free products are only available in supermarkets. 28.8% said that they did know about the availability of gluten free products only in supermarkets. 14% and 3.2% disagreed and strongly disagreed respectively with the statement that gluten free products are available only in supermarkets. 10% and 32% of the participants strongly agreed and agreed respectively that rice, corn, and millet are the only substitutes of wheat. 22.4% said that they did not know whether rice, corn and millet were the only substitutes of wheat. 29.6% and 6% of the

participants disagreed and strongly disagreed respectively with the statements that rice, corn, and millet are the only substitutes of wheat. 19.6% of the participants strongly agreed that sorghum is a natural gluten free grain while 38.4% agreed that sorghum is a natural gluten free grain. 37.2% participants said that they did know whether sorghum is a natural gluten free grain or not. Only 4% and 0.8% of the participants disagreed and strongly disagreed respectively with the statement that sorghum is a natural gluten free grain. 12.8% of the participants strongly agreed that sorghum can be used for celiac patients while 46% agreed that sorghum can be used for celiac patients. 38% participants said that they did know whether sorghum can be used for celiac patients or not. Only 2.8% and 0.4% of the participants disagreed and strongly disagreed respectively with the statement that sorghum can be used for celiac patients. 8.4% of the participants strongly agreed that sorghum is only available in supermarkets while 30.4% agreed that sorghum is only available in supermarkets. 42.2% said that they did know about the availability of sorghum only in supermarkets. 16% and 2.8% of the participants disagreed and strongly disagreed respectively with the statement that sorghum is available only in supermarkets. 8% of the participants strongly agreed that sorghum is a cheap cereal in Pakistan while 32% agreed that sorghum is a cheap cereal in Pakistan. 42.2% said that they did know whether sorghum is a cheap cereal in Pakistan or not. Only 9.2% and 1.6% of the participants disagreed and strongly disagreed respectively with the statement that sorghum is a cheap cereal in Pakistan. 9.6% of the participants strongly agreed that sorghum flour can be used to make chapatti while 46.8% agreed that sorghum flour can be used to make chapatti. 36.4% said that they did know whether sorghum flour can be used to make chapatti or not. Only 6% and 1.2% of the participants disagreed and strongly disagreed respectively with the statement that sorghum flour can be used to make chapatti. 12% of the participants strongly agreed that sorghum flour can be used for making biscuits, pasta, and noodles while 45.6% agreed that sorghum flour can be used for making biscuits, pasta, and noodles. 38% said that they did know whether sorghum flour can be used for making biscuits, pasta, and noodles or not. Only 4% and 0.4% of the participants disagreed and strongly disagreed respectively with the statement that sorghum flour can be used for making biscuits, pasta, and noodles.

Table 2: Chi-Square Test of Association with Sorghum as a Natural Gluten Free Cereal

Variables	P-value
Knowledge about food and nutrition	0.000
Knowledge about celiac disease	0.000
Family history	0.000

Do they follow a specific diet	0.030
Only rice, corn and millet are wheat substitute	0.000
Sorghum can be used for celiac patients	0.000
Sorghum is only available in supermarket	0.000
Sorghum is cheap cereal in Pakistan	0.000
Sorghum flour can be used to make chapatti	0.000
Sorghum flour can be used for making biscuits, pasta, and noodles	0.000

It is observed from table 2 that variables knowledge about food and nutrition, knowledge about celiac disease, family history, do they follow a specific diet, only rice, corn and millet are wheat substitute, sorghum can be used for celiac patients, sorghum is only available in supermarket, sorghum is cheap cereal in Pakistan, sorghum flour can be used to make chapatti, sorghum flour can be used for making biscuits, pasta and noodles have a p- value less than the level of significance that is 0.05 hence all of them have a highly significant relationship with the variable sorghum as a natural gluten free cereal.

3. Discussion

Most commonly used gluten free cereals include corn and rice but there are chances that they can activate gut inflammation. On the other hand, remarkable functional and nutritional properties of sorghum make it a better option from other available gluten free cereals. This study aims to assess the knowledge, attitude, and practices about the use of sorghum as a gluten free cereal. Awareness of finest and easily available gluten free reserve is essential especially among the people of developing countries like Pakistan where people with celiac disease suffer a lot due to lack of knowledge and availability of gluten free substitutes. Half (50%) of the study population who had the knowledge of celiac disease know about gluten free nature of the cereal whereas, 7.2% population who have knowledge of sorghum did not have the knowledge celiac disease.18.8% population who have the knowledge of sorghum have the family history of disease whereas, 30% of the study population have the information about sorghum but do not have family history of disease. 26.8% population even being aware of sorghum thinks that only rice, corn and millet are used as a substitute for gluten containing products. Only 27.6 population disagreed with statement.50.4% population who were aware of sorghum thinks that it can be used for celiac patients whereas, only 8.4% disagreed with the statement. 28.4% of population even being aware of gluten free nature of sorghum thinks that it is only available in

supermarket and not locally whereas, 29.6% either disagreed or did not have its knowledge. Only 32% population thinks that sorghum is a cheap cereal in Pakistan but 6% disagreed with the statement and thinks that it is an expensive cereal.46% of the study population thinks that sorghum being gluten free cereal, its flour can be used to make whereas,26% of them either did not know or disagreed with the statement. 47.2% population thinks that its flour can be used to make biscuit, pasta and noodles. 53.6% of study population who know about gluten free nature of sorghum cereal have the knowledge of food and nutrition whereas, 32% of study population who have the knowledge of food and nutrition did not have the knowledge about gluten free nature of sorghum. Above discussion reflects that most of the people are well aware about sorghum as a natural gluten free cereal but still a significant number of students are not fully aware of sorghum, its availability and use. A study done by Gabriel Samasca, Genel Sur, Iulia Lupan and Diana Deleanu (2014) assist the present study that gluten free diet has positive effects in celiac disease patients. This study is an agreement with the study conducted by D Chávez, JLR Ascheri, A Martins,CWP de Carvalho, C Bernardo and A Teles (2018) according to which sorghum is nutritionally and functionally enriched gluten free cereal. It can be used by celiac patients and different gluten free products and could be made by using sorghum. A study conducted by OQ Adiamo, OS Fawali and B Olawoye (2018) supports the current study according to which sorghum can be used to make bread, different types of noodles and other baked products. The current study is an agreement conducted by Alastair Orr, Albert Gierend and Dyutiman Choudhary (2017) as it supports the fact that sorghum is one of the cheapest as well as finest gluten free substitute when compared with wheat flour and maize meal and will become cheaper in coming years.

4. Conclusion

Sorghum is a natural gluten free cereal available and grown in Pakistan which can be used for celiac patients. The above study revealed that there is a significant population who did not have a complete knowledge about the use, benefits, and accessibility of sorghum even in students who had the knowledge of food and nutrition. There is a need to enhance the education and awareness about this natural, cheap gluten free substitute so that it could be effectively by the general population.

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