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## Availability and cost of gluten-free products in Algeria

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### Abstract

**Purpose** – A strict gluten-free diet (GFD) is the only effective treatment for coeliac disease, which has an increasing prevalence. However, the limited availability and high price of gluten-free products (GFP) compared to their gluten-containing counterparts (GCC) are still among the factors that may influence compliance with a strict GFD. The purpose of this study is to assess the availability and price of GFP in retail stores in a major Algerian city and investigate how they compare to GCC.

**Design/methodology/approach** – We performed a cross-sectional study that targets a representative number of supermarkets and grocery stores in Constantine (Algeria). All available GFP were recorded as well as their GCC. The price per 100 g was recorded for each product.

**Findings** – Among the 285 visited stores, only 25.4% of them sold GFP, which were more available at supermarkets than at grocery stores. The category “gluten-free pasta and couscous” was the most represented (43.8%). A total of 64 GFP were observed across 285 stores investigated and their price was two to six times higher than that of their GCC.

**Originality/value** – This study showed the limited availability and diversity and higher price of processed GFP in Algeria. This negatively influences compliance with GFD as well as the quality of life of patients with coeliac disease. Furthermore, the findings prompt the national government to provide a financial support to coeliac individuals.

**Keywords** Coeliac disease, Gluten-free diet, Availability, Price, Gluten-free product

## Introduction

Coeliac disease (CD) is a chronic immune-mediated enteropathy triggered by gluten ingestion in genetically predisposed individuals (Fasano and Catassi, 2012; Ludvigsson *et al.*, 2013). CD is one of the most common chronic digestive disorders worldwide, with an increasing prevalence between 0.7 and 1.4% (Shannahan and Leffler, 2017; Singh *et al.*, 2018). **In Algeria, the national prevalence of CD is unknown. However, it was around 0.10% in some Algerian cities between 2007 and 2014 (Boudraa *et al.*, 2008; Bouasla *et al.*, 2011a; Boukezoula *et al.*, 2015).**

Currently, **a strict life-long gluten-free diet (GFD) is the only known effective treatment for CD and other gluten-related disorders** (Bascuñán *et al.*, 2017; Caio *et al.*, 2019). Interestingly, some non-coeliac people also follow the GFD, as the diet has become fashionable (Rosell and Matos, 2015). This diet consists of foods that can be naturally GF (e.g., vegetables, fruit, fish, unprocessed meats, and dairy products) **and/or** processed foods labelled GF (e.g. bread, pasta, and biscuits), where gluten-containing grains are replaced by GF substitutes (e.g., rice, corn, or starch) (Ciacci *et al.*, 2015). According the Codex Alimentarius (FAO/WHO, 2015), products are considered GF when they contain less than 20 **mg/kg (ppm) of gluten**.

Although there is no doubt about the benefits of the GFD **for patients with CD and other gluten-related disorders**, several studies showed that the high price of gluten-free products (GFP) compared to their gluten-containing counterparts (GCC) has become a financial burden for **patients with CD worldwide** (Lambert and Ficken, 2016; Fry *et al.*, 2017; Guennouni *et al.*, 2022) **and in Algeria (Bouasla *et al.*, 2011b; Meghzili *et al.*, 2021).**

Worldwide, the global market size of GFP was valued at \$6.45 billion in 2022 and is expected to grow at a compound annual growth rate of 9.8% from 2023 to 2030 (Grand View Research, 2024). However, the growing market of GFP has not improved significantly the accessibility of GFP or decreased their prices (Hanci and Jeanes, 2019).

The availability and cost of GFP are among the factors that may affect adherence to a GFD and patient's quality of life (Hall *et al.*, 2009; Roma *et al.*, 2010; Singh *et al.*, 2011). Moreover, evaluating availability and cost helps understand the current market for GFP and the accessibility to GFP by people with **CD** (Vriesekoop *et al.*, 2020). Unfortunately, to the best of our knowledge, such study has never been performed in Algeria. Therefore, the present study aimed to investigate the availability and cost of **processed** GFP compared to their GCC in a major Algerian city.

## 2. Material and methods

### 2.1. Stores

A total of 285 retail stores (47 supermarkets and 238 grocery stores) were surveyed in Constantine, Algeria. For the sake of this study, grocery stores are smaller retail outlets that typically sell foods and beverages plus basic non-food items, while supermarkets are larger and more comprehensive retail outlets that sell a much wider range of food and non-food items. To take into consideration the differences in availability and cost, **the stores were selected randomly and** were geographically distributed in a balanced way over all the regions of Constantine.

## *2.2. Food categories*

**Processed GFP** were categorized into 8 food categories according the Algerian Products Nomenclature (Office National des Statistiques, 2022): “Flour and bake mix”, “Semolina and groats”, “Pasta and couscous”, “Biscuits and cakes”, “Preparations and fruits preserves”, “Chocolates and confectionery”, “Baby porridges”, and “Miscellaneous”. These categories reflect groups of **processed** gluten-containing foods. **The latters were selected based on their description that most closely matched that of GFP.**

**Naturally GF products (e.g. rice, vegetables, fruits, eggs and meat) were not included in the present study.**

## *2.3. Survey procedure*

A cross-sectional retail survey was performed between March and May 2022 in Constantine, Algeria. First, we obtained authorization from the store’s manager to collect of the available products (gluten-free and their gluten-containing counterparts). Items were considered to be GF if they were explicitly labelled “gluten-free”; otherwise, they were classified as regular.

In each store, we first looked for the presence or the absence of GFP. For stores that sold GFP, we recorded the number of gluten-free and gluten-containing products, the category of the product and their price. The latter of all products was recorded in the local Algerian currency (Algerian Dinar, AD), then converted to the European Union currency (Euro), expressed per 100 g of product.

The currency conversion from the Algerian Dinar to the European Union currency was performed on the basis that  $1 \text{ AD} = 0.0064 \text{ €}$ , according to the official “Bank of Algeria” (Bank of Algeria, 2022).

Photos of the available products were taken to collect the following information: brand name, weight, and origin of the product (local or imported product).

## *2.4. Statistical analysis*

**The normality of the data was evaluated by the Shapiro-Wilk test. The Levene test was applied to examine the homogeneity of variances. Comparison between the prices of GFP and GCC**

was tested according to the data normality and the variances homogeneity of variables. Variables with normal distributions were reported on mean  $\pm$  standard deviation and compared with the Student t-test, while the variables with abnormal distribution were indicated in median (interquartile range, IQR) and compared with the Mann–Whitney U test.

All statistical tests were performed at a significance level of 0.05 using Statistica 10.0 software (StatSoft, Inc., Tulsa, OK, USA).

### **3. Results**

#### *3.1. Availability of gluten-free products*

In the 285 stores visited in Constantine (47 supermarkets and 238 grocery stores), only 71 stores (25.4%) sold GFP, which included 34 supermarkets (72.3%) and 14 grocery stores (5.9%).

In both stores, a total of 64 GFP were found, and 58 GCC were selected and distributed in 8 categories (Table I).

The category of “GF pasta and couscous” is the most represented with 28 products (43.8%), followed by the category of “GF flour and bake mix” with 12 products (18.8%) and the category of “GF biscuits and cakes” with 6 products (9.4%). The categories of “GF semolina and groats”, “GF preparations and canned fruits”, “GF chocolates and confectionery”, “GF baby porridges”, and “GF miscellaneous” are the least identified by a prevalence of 6.3, 4.7, 7.8, 3.1 and 6.3%, respectively.

All the foods categories investigated in the current study were available in the supermarkets at 100% (8/8). However, the availability was 75% for grocery stores (6/8) that sold all foods categories except “GF chocolates and confectionary” and “GF miscellaneous”.

It is worth noting that 86.2% of GFP are from local brands while GFP manufactured abroad represented 13.9%.

#### *3.2. Price of GF products*

Table II shows the price (€/100 g) of GF products compared to their regular counterparts. With the exception of the “GF baby porridge” category, all GF products categories presented significant higher mean prices in comparison to the mean prices of regular products. GFP are 137% more expensive than their regular counterparts. The difference is significant for all categories (67–480%). The excess price is very high for the categories “GF flour and bake mix”, “GF pasta and couscous”, GF chocolates and confectionery”, and “GF biscuits and cakes”, reaching 480, 360, 236, and 228%, respectively. The other categories “GF semolina and groats”, “GF preparations and canned fruits” and “GF miscellaneous” presented a less important excess price, costing 123, 195, and 67% more.

#### 4. Discussion

The present study is the first attempt to present a dataset comparing GFP and their regular counterparts available in Algeria.

Our study has identified 64 GFP in the 285 stores visited. This number is considered very limited compared to the number of regular products available in Algeria. The number of GFP that this study has identified remains very low compared to the number of GFP available in other countries: 271 in Morocco (Guennouni *et al.*, 2022), 266 in United Arab Emirates (Abdulla and Garemo, 2018), 168 in Brazil (Do Nascimento *et al.*, 2014) and on the other end of the scale 1872 in the UK (Vriesekoop *et al.*, 2020) and 2226 in Canada (Jamieson and Gougeon, 2017).

In Algeria, GFP are less available than their regular, gluten-containing counterparts. This low availability was also reported in other Arab countries like Morocco (Guennouni *et al.*, 2020) and the United Arab Emirates (Abdulla and Garemo, 2018), USA (Lee *et al.*, 2019), and American Latin countries such as Brazil (Do Nascimento *et al.*, 2014), Chile (Estevez *et al.*, 2016), and Mexico (Arias-Gastelum *et al.*, 2018).

Several studies reported the coeliac person's dissatisfaction with GFP availability (Sverker *et al.*, 2005; Zarkadas *et al.*, 2006; Araújo and Araújo, 2011; Vriesekoop *et al.*, 2020), a situation that is one of the greatest difficulties for GFP purchase. This difficulty limits food choices, makes the diet monotonous, affects daily life management (Sverker *et al.*, 2005; Do Nascimento *et al.*, 2014;), and may contribute to increase the anxiety and depression related to food choice found in **patients with CD** (Van Hees *et al.*, 2013). Thus, this difficulty negatively affects the adherence to the GFD and the quality of life (Guennouni *et al.*, 2022).

Furthermore, since the availability of GFP is limited, several features are automatically ignored (e.g. product quality, product price, health and nutrition, sensorial aspects, and the needs and preferences of the people with whom one lives), despite these features would be considered in other situations. Therefore, the food choices of coeliac patients are made over a lack of alternatives rather than being conceptual (Do Nascimento *et al.*, 2014).

All GF products categories, except the "GF baby porridge" category, are significantly more expensive than their regular counterparts. GFP were approximately 2 to 6 times more expensive than their regular counterparts. These findings were expected and confirm that reported in Arab countries (Abdulla and Garemo, 2018; Guennouni *et al.*, 2022), European countries (Singh and Whelan, 2011; Burden *et al.*, 2015; Panagiotou and Kontogianni, 2017; Capacci *et al.*, 2018; Fry *et al.*, 2018; Hopkins and Soon, 2019; Vriesekoop *et al.*, 2020), American Latin countries (Do Nascimento *et al.*, 2014; Estevez *et al.*, 2016; Oyarzún *et al.*, 2016; Arias-Gastelum *et al.*,

2018), Canada (Stevens and Rashid, 2008; Kulai and Rashid, 2014), USA (Lee *et al.*, 2007; Lee *et al.*, 2019), and Australia (Missbach *et al.*, 2015; Lambert and Ficken, 2016).

The possible reasons for the high cost of GFP may be related, on the one hand, to the price of alternative GF grains (corn, sorghum, pseudo-cereals, millet, etc.) used to replace gluten-containing grains, as well as the price of additives to improve the product's properties (e.g. xanthan gum) (Demirkesen and Ozkaya, 2020; Woomer and Adedeji, 2021). On the other hand, to the cost of considerable technological expertise needed for product development (replacement of gluten functionality) and product quality control for gluten absence (Demirkesen and Ozkaya, 2020; Guennouni *et al.*, 2022).

The high economic burden of CD is another difficulty that could increase the noncompliance to a GFD, mainly for patients with lower socioeconomic status, which is crucial for both long-term and short-term health (Burden *et al.*, 2015; Allen and Orfila, 2018). In fact, non-adherence to the GFD is a factor that contributes to rise the mortality rate in coeliac patients (Corrao *et al.*, 2001), as well as to worsen the quality of life compared with those with good adherence to the diet (Usai *et al.*, 2002).

To face the financial burden related to the expensive prices of GFP and to incentive the compliance with GFD, several countries adopt various strategies such as food provision, prescription, cash transfer, tax reduction, and subsidy (Pinto-Sanchez *et al.*, 2015; Falcomer *et al.*, 2020).

Spain and the United Arab Emirates adopt direct GF food supply. However, in the United Arab Emirates, only GF flour is received for free (Abdullah and Garemo, 2018).

In the UK, coeliac patients can receive prescriptions for GF staple foods at a significantly lower price. These prescriptions are covered by the national health care system (Violato *et al.*, 2012; Coeliac UK, 2024). However, prescribing guidelines depend on where the coeliac patient live (Coeliac UK, 2024). The same system is also adopted in New Zealand (Coeliac New Zealand, 2024).

In other countries as USA, Canada, Romania, Ireland, and Portugal, patients with CD are eligible to tax reduction or discounts to purchase GF foods as a financial incentive (Falcomer *et al.*, 2020).

An interesting strategy that may facilitate GFD adherence and minimize food inaccessibility is giving a governmental financial support/food allowance to buy GF food. Nevertheless, only 13.5% of the countries members of the World Health Organization have this type of policies (Falcomer *et al.*, 2020). Among these countries, Italian coeliac patients receive a food allowance about 140 €/month on strict terms (Celiac Disease Foundation, 2024). Greece has a

food allowance provided by the National Health Services Organisation for GF cereal based-products. This allowance is €100 and €120 per month for adults and people under 18 years old, respectively (Panagiotou and Kontogianni, 2017).

The reimbursement of coeliac patients for GF foods is a strategy adopted in France on specific conditions (Association Française Des Intolerants Au Gluten, 2024).

Only 6 countries (UK, Italy, the Netherlands, Slovenia, Sweden, and France) achieved the maximum “Public Policies for Celiac Disease Score” established by Falcomer *et al.* (2020) to assess the level of assistance for coeliac patients. In contrast, more than half (52.6%) of the World Health Organization members did not score any points, corresponding to an alarming situation (Falcomer *et al.*, 2020). Unfortunately, none of the above-mentioned procedures are currently adopted in Algeria. This situation makes the management of CD difficult, resulting in poor adherence to GFD and low quality of life, especially for patients with CD or any other gluten-related disorder with low socioeconomic income.

Our study has some limitations. First, the study was only carried out in one geographical area (a single Algerian city) which may limit the ability to generalize our findings to the country as a whole. However, we visited a representative number of stores and covered all the boroughs of the city. Second, we investigate only packaged GFP, which exclude some unpackaged GFP that many coeliac people purchase. Third, we only visited supermarkets and grocery stores and some GFP may be available in other venues such as health food stores and pharmacies. However, supermarkets and grocery stores are the points of sale where most people purchase their food products.. Therefore, this would be points to consider in future investigations.

Despite the limitations of the study, there are many several strengths such as, according to our knowledge, our study is the first of its kind in Algeria, providing new information about the potential GFP inaccessibility for Algerian coeliac patients. Another strength of the study is that it covers all packaged GF foods sold in supermarkets and grocery stores.

## **5. Conclusion**

This study reveals that GFP in Algeria are not very available with very limited amount and variety and very expensive prices. This situation may have a powerful negative influence on the GFD adherence for patients with coeliac disease in Algeria, with detrimental consequences to their health and quality of life.

To overcome that, the financial burden of GFD need to be addressed. The results obtained in this work could be extremely beneficial to adopt a public policy that guarantees GF food accessibility for coeliac patients and those suffering from gluten related disorders, especially those with low financial income. Thus, a national financial governmental support for patients



who rely on GFP is desirable. Furthermore, increasing local production of GFP may contribute to the diversification of GF foods and decreasing their cost.

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*Ethical considerations:* This study did not include human patients.

*Conflict of interest:* None.

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