NUTRITIONAL MODEL BASED ON VEGETABLES AND FRUITS OF CUCURBITACEAE: CASES OF TYPE 2 DIABETICS HAVE A MODERATE INFECTION OF COVID-19

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Abstract

The balanced diet of type 2 diabetics remains an effective recommended solution for the treatment of the disease, but in the case of infection with COVID-19 can complicate the situation and give a new problem of nutritional balance between several carbohydrate compositions, from lipids, proteins, vitamins, oligoelements, ... in this theme, a model based on cucurbitaceous foods has been developed which responds to the energy and nutritional intake in diabetics during moderate COVID-19 infection. Seven vegetables and fruits have been defined such as: cucumber, pickle, zucchini, squash, squash, watermelon and melon. A statistical study was done using principal component analysis (PCA) which proved the correlation between the selected foods and energy and nutritional requirements. The model significantly demonstrates its energy importance which meets the daily needs of diabetics according to the low composition of carbohydrates, lipids and proteins, in addition to the remarkable contents of vitamins and trace elements, particularly vitamin C.

Keywords: Cucurbitaceae, diet, type 2 diabetes, COVID-19, statistical modeling.

Introduction

In the context of the international response to the COVID-19 pandemic and in order to control its impact on health, the strengthening of immunity, through measures to preserve and promote nutrition, it is essential in with a view to maintaining the achievements of the global nutrition program and preserving the well-being of the population in this exceptional epidemiological context, particularly diabetic patients [1-2]. It goes without saying that good nutrition management in diabetics plays a vital role in the development and maintenance of the immune system, which helps protect against infectious diseases and helps recovery quickly [3]. Healthy and balanced diets are also necessary to prevent the emergence of noncommunicable diseases, which are risk factors linked to increased rates of morbidity and mortality for people infected with COVID-19 [4].

Food contains elements essential for the proper functioning of the body: proteins, lipids (fats) and carbohydrates (food sugars). The most important thing is to limit fatty foods in order to control your weight: oil, butter, cheese, cold meats, … [5-6] In fact, overweight is the main cause of diabetes, in a specific area. If the weight goes up, the blood sugar goes up, and losing weight if you are overweight can improve or even correct blood sugar levels. The consumption of foods containing carbohydrates has a direct impact on blood sugar levels, resulting in a weak immune system which can give multiple side effects in cases of virus infections. the massive carbohydrate nutrition will therefore cause hyperglycemia which tends towards complications until death [7]. The absence of carbohydrates during the meal can cause a dietary imbalance, sometimes even cause hypoglycemia if the treatment is too strong, and we must therefore look for other suitable alternatives to balance the human body [8].

Several models have been proposed by doctors and / or specialists of food technology for nutrition in diabetics [9-10]. But during the COVID-19 pandemic which caused by the infection of the coronavirus, several models were developed, more specifically of strengthening the immune system by dietary supplements and vitamins like magnesium, vitamin C, vitamin D and on the other hand, to balance blood sugar in diabetics [11]. In addition to drugs, it is necessary to ensure an adequate intake of energy and protein in the daily diet while respecting the needs required for each gender and age group, thus, diabetic patients with risk factors or underlying diseases such as hypertension, cardiovascular disease, respiratory disease, cancer under treatment, autoimmune disease and people who use immunosuppressive drugs or smokers [12-14].

The main objective of this work is to propose a food model in diabetics infected by COVID-19 based on vegetables and fruits of the Cucurbitaceae family through more in-depth statistical studies. This diet, which was developed by a study by our team of Abdoul-Latif et al. (2021) [15], and which has been shown to be effective in reducing blood sugar in three patients due to the low composition of carbohydrates, proteins and lipids as well as its richness in vitamins and oligoelements.

Materials and Methods

Data sources

All data has been taken from our previously published work [15-16]. The data are the energetic and nutritional compositions of foods which present some vegetables and fruits of the Cucurbitaceae family, such us: cucumber, pickle, zucchini, squash, squash, watermelon and melon.

All the data produced are presented in table 1, which presents the composition of food in 100 g (approximation) of the nutritional model proposed based on vegetables and fruits of cucurbits in the form: energy, water, carbohydrates, proteins, lipids, vitamin C and zinc.

Statistical methods

The relationship between fruits and vegetables of the Cucurbitaceae family and their energy and nutrient composition was studied by principal component analysis (PCA) and hierarchical clustering [17]. These two statistical methods are one of the most important approaches to explore multivariate data. The goal is to know and identify clusters of similar objects in a dataset of studied variables, more precisely, on the dietary vision of the diet applied to propose and identify a well-

defined energy and dietary composition of the foods offered.

Results and discussions

Diabetes is associated with a more severe and unfavorable course of SARS-CoV-2 infection [18]. It is important to note that this population with severe complications is often elderly and suffers from other major comorbidities, often metabolic and cardiovascular. There is no indication to change the anti-diabetic treatment to prevention [19]. However, strict monitoring and glycemic control recommendations should be made in the event of infection. In the event of severe forms, the non-insulin antidiabetics all present their own risks. The use of intensified insulin therapy will therefore be necessary to aim for glycemic control, protecting the patient from the risk of secondary infection [20].

On the other hand, the immune system, like other systems in the body, needs enough nutrients to function properly. Nutrition has been studied as a factor to alter the influence on the functioning of the immune system for decades, and research in this area has become an important topic called nutritional immunology [21].

The use of well-defined diets in diabetic patients can minimize infections and / or viral risks particularly COVID-19. In order to prevent and strengthen the immune system, it is necessary to ensure an adequate intake of energy, carbohydrates and proteins in the daily diet while respecting the needs required for each gender and each age group, taking into account the recommendation to drink enough fluids, especially water [22-23].

Our work described above has shown the effectiveness of a proposal for a diet based on vegetables and fruits of the Cucurbitaceae for the control of the blood sugar level and the concentration of glycated hemoglobin, especially cucumber, pickle, zucchini, squash, squash, watermelon and melon, which have a low composition of carbohydrates, lipids and proteins, a moderate energy intake and a high water composition. All the values of the energy and nutritional composition of these seven foods are displayed in Table 1.

As we have described, Principal Component Analysis (PCA) is a statistical tool to study the correlation between selected cucurbits foods and nutritional composition, as well, to determine hidden information.

The case that we are going to study crosses the seven foods (cucumber, pickle, zucchini, squash, gourd, watermelon and melon) and the seven variables essential for the nutrition of diabetic patients during COVID-19 infection (energy, water, carbohydrates, proteins, lipids, vitamin C and zinc).

To fully explain the results, we must start with the choice of the axes that are interesting for our analysis. Table 2 presents the eigenvalues of the four (4) presentative axes obtained. According to Bartlett's test, the axes F1 and F2 were retained whose eigenvalues are correlated (λ_1 = 6.57 and λ_2 = 0.33), with variabilities of 93.84% and 4.76% respectively, corresponding to the total of 98.60% of the information. These eigenvalues of the selected axes return a "good proportion" of the analysis, this means that the sum of the inertia explained by each of the axes represents a significant part of the total inertia.

In the mapping shown in Figure 1, we can see that all the foods of the Cucurbitaceae family are very close to the correlation circle towards the F1 axis and therefore very well represented on the mapping. The rather closed angle (starting from the origin) formed by the cucumber points: $\cos^2 (\theta)$ = 0.93, pickle: $\cos^2 (\theta)$ = 0.78, zucchini: $\cos^2 (\theta)$ = 0.90, squash: $\cos^2 (\theta)$ = 0.99, gourd: $\cos^2 (\theta)$ = 0.98, watermelon: $\cos^2 (\theta)$ = 0.98 and melon: $\cos^2 (\theta)$ = 0.99, indicate that these seven variables are well correlated with each other. These results come back to the addiction of selected foods from the Cucurbitaceae family. In addition, figures 2 and 3 show that the foods of the Cucurbitaceae family are correlated with the two nutritional parameters: energy and water, on the other hand no relation with other parameters such as: proteins, carbohydrates, lipids, vitamin C and zinc.

Figure 4 gives two dendrograms which graphically represent an ascending hierarchical classification and which can classify on the one hand the cucurbitaceous foods (a) and on the other hand, the energy and nutritional composition (b). The

cucurbits are classified in the form of 3 groups: the 1st group contains only the pickle with a very high energy and nutritional contribution, consequently the watermelon in the 2nd group and finally a 3rd group which assembles the other 5 remaining foods. At the same time, water remains the most important content in these foods, depending on energy and other nutritional compositions such as: carbohydrates, lipids, proteins, vitamin C and zinc remain in very low levels.

Cucurbitaceae are excellent for lengthy feeding efforts, especially in diabetics during the COVID-19 pandemic. they guarantee an immediate energy supply, with their vitamin C content, the latter strengthen the immune system and it has important anti-inflammatory properties [15]. Then, they contain low levels of carbohydrates, lipids and proteins which implies regulation of blood sugar. This family of foods has many elements that help the body to recover from intense training, they are rich in trace elements such as magnesium, phosphorus and calcium, so they contain a wide range of other vitamins, especially vitamin A and B vitamins [24]. These foods are recommended during a diet. They are relatively low in sugars, high in fiber and low in calories. On average, cucurbits are 2.5 times less caloric than potatoes. They can therefore replace tubers and starches to accompany proteins during the diet or in the context of a viral infection [25].

The proposed diet based on vegetables and fruits of Cucurbitaceae has disadvantages detected experimentally and theoretically, particularly the low protein content and the absence of vitamin D which is essential in strengthening the immune system during infection with COVID-19. , this can recommend the use of food supplements, and the second disadvantage the effect of some drugs intended for type 2 diabetics which give a consequence of deficiency in certain vitamins.

Conclusion

This study aims to propose a diet based on vegetables and fruits of the Cucurbitaceae family for diabetics infected with COVID-19 in a moderate situation. The diet contains seven foods such as: cucumber, pickle, zucchini, squash, squash, watermelon and melon, it has an important energy composition and adequate nutritional composition with the balance of diabetics during COVID-19, hence the Diet has low levels of carbohydrates, fats and proteins, as well as acceptable levels of vitamin C and zinc. The latter have been recommended in treatment protocols for COVID-19 by all government health sectors around the world. A statistical study was done by PCA which showed the dependence of all foods on their nutritional composition, thus proving the effectiveness of this diet according to the interpretations of the calculated data. This diet remained limited by several disadvantages which remain a handicap of the application, particularly the absence and / or the deficiency of several elements which can strengthen the immune system in the case of COVID-19 such as the absence of vitamin D and the weak zinc contents, and secondly, the effect of anti-diabetic drug treatment for each patient.

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Table 1. Energy and nutritional composition of vegetables and fruits used for the proposed diet based on vegetables and fruits of Cucurbitaceae.

Food	Cucumber	Pickle	Zucchini	Squash	Gourd	Watermelon	Melon
Energy (kcal/100g)	15	130	17	40	19	30	36
Water (g/100g)	99	62.1	94.8	87.7	89.2	91.5	89.8
Proteins (g/100g)	0.7	1.1	1.2	0.8	1.1	6	0.5
Carbohydrates (g/100g)	3.6	35.1	3.1	10.4	4.1	7.5	9.1
Lipids (g/100g)	0.1	0.5	0.3	0.1	0.2	0.5	0.1
Vitamin C	2.8	1	17.9	11	11.4	8.1	18
Zinc (mg/100g)	0.2	0.1	0.3	0.1	0.1	0.1	0.1

Table 2. Eigenvalues of the presentative axes of the PCA.

	F1	F2	F3	F4	F5
Own value	6.57	0.33	0.08	0.01	0.01
Variability (%)	93.84	4.76	1.13	0.19	0.08
cumulative%	93.84	98.60	99.73	99.92	100.00

Figure 1. Correlations of foods of the Cucurbitaceae family between them.

Variables (axes F1 et F2 : 98,60 %)
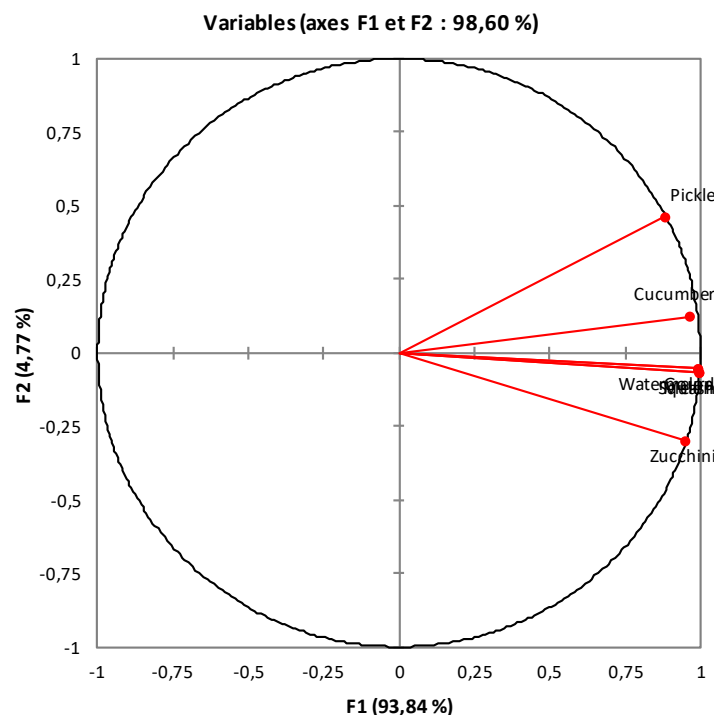
Figure 2. Distribution of the energy and nutritional composition on the two axes F1 and F2.

Observations (axes F1 et F2 : 98,60 %)
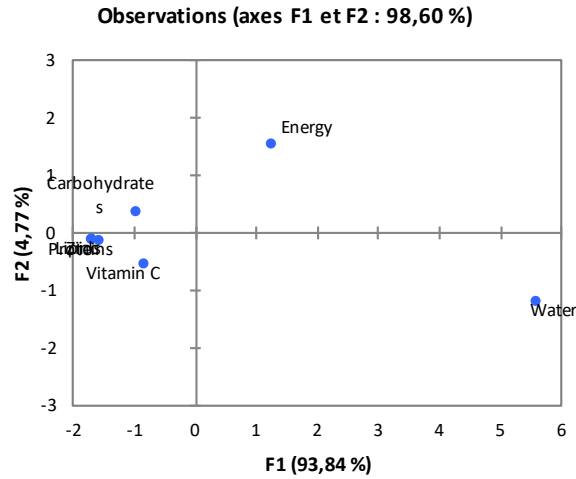
Figure 3. Biplot of correlation between cucurbitaceous foods and energy and nutritional composition.
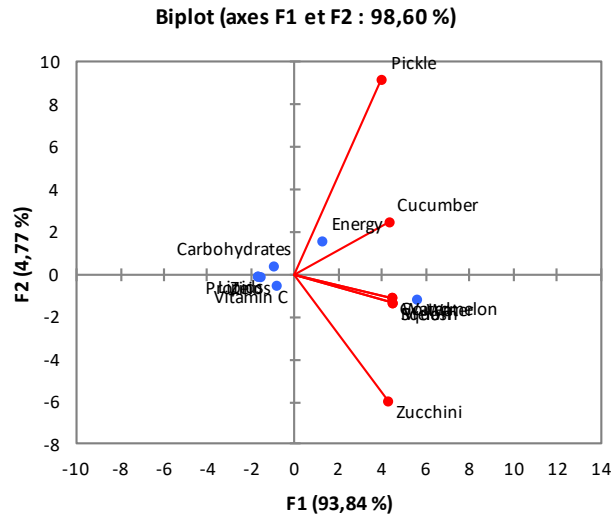

Biplot (axes F1 et F2 : 98,60 %)

Figure 4: Parameter correlation dendrograms. (a) food classifications; (b) classifications of energy and nutritional composition.