Dental Caries among Tasters and Non-Tasters of PTC Substance in Students of Qurna Population

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Received: April 7, 2019 Accepted: June 1, 2019 Online Published: October 23, 2019
doi:10.5539/jmbr.v9n1p82 URL: https://doi.org/10.5539/jmbr.v9n1p82

Abstract

Objective: Dental caries is one of the most common diseases found in human populations and it is still prevalent and widespread in all around the world. newer strategies emphasize disease prevention as a model of disease management. For early detection and monitoring of caries rather than treatment Taste has valuable roles in our lives in health and disease. genetic markers such as PTC substance taste ability may represent a useful tool to predict the susceptibility to caries. This study aims to investigate the relationship between the taste ability of phenylthiocarbamide (PTC) substance and dental caries.

Materials and Methods: The current study was conducted from November 2017 to April 2018 in Qurna and Madiana population/Basrah/Iraq, PTC taste sensitivity was determined among random sample of (406) student from primary and secondary schools; 216 males and 190 females, their ages ranging from (6-17) years old. For dental caries assessment, dmft/DMFT scores were recorded. Individuals were divided into three groups (low, high and very high) according to their dental caries severity in addition to the free caries individuals.

Results: The proportion of tasters were higher as compared to non-tasters in this sample. The results showed an increase in the prevalence of caries among primary(68%) and secondary (57.6%) school’s students respectively and for both of them (64.03%). In primary school; females had an elevated percentage of caries (73.1%) compared to their counterpart males (65%). The results of this study did not show a significant relationship between the taste of PTC substance and dental caries, with equal proportions of caries prevalence among tasters and non-tasters (P > 0.05). However, the results showed significant differences in age effect in the prevalence of dental caries among primary and secondary students as it increased in individuals of the age group (6-12) years compared to the age group (13-17) years.

Conclusion: The results of this study did not show a significant relationship between the taste of PTC substance and dental caries. In other hand age have a significant influence especially in primary age school and females were more affected than males. The appearance of the two phenotypes of PTC taste may be due to the involvement of other genes, rather than the PTC gene only, including CA6 gene and its variation , which in turn affects the pH capacity of the saliva, a factor associated with tooth decay. Due to the multifactorial nature of dental caries, the individual’s vulnerability may differ from one to another. In addition, particularly regarding diet, part of the strategy to be adopted can be defined as health promotion by preventing the occurrence of the disease rather than treatment. Integrating a healthy dietary regimen into the daily routine can have a real influence on oral health and can be regarded as a primary step towards caries prevention. future research efforts should continue to emphasize early detection and caries prevention strategies.

Keywords: PTC Sensitivity, Taste, Dental Caries, Tasters, Basrah/Qurna Population, dmft/DMFT

1. Introduction

Taste is divided into four main senses: salty, sweet, sour and bitter. A fifth called umami (meaty or delicious) and sixth type also had been found for tasting amino acids and fatty acid texture respectively (Chaudhari & Roper, 2010; Ebba et al., 2012; Melis et al., 2018). Taste has a valuable role in our lives. All types of taste have significant roles for living and survival; in health and disease. Bitter taste has gained special developmental importance; it has contributed to human survival by warning it from ingesting toxins (usually have a bitter taste), which are widely dispersed by nature in plants or in others (Wooling et al., 2004; Sandell & Breslin, 2006;
Receptors of bitter taste had a great variation (about 25 genes) which indicates their importance in sensing multiple types of materials that are biologically important (Viswanathan, 2013; Farquhar et al., 2015; Verbeurgt et al., 2017). Discovering the presence of many bitter taste receptors in extra oral cavity in some organs and glands (Clark, 2014; Wölfle et al., 2015; Lu et al., 2017; Tan et al., 2018); confirmed their important biological roles in digestion, food metabolism and in the prevention of certain diseases (Dotson et al., 2010; Campa et al., 2012; Newcomb et al., 2012; Choi, 2014; Lu et al., 2017).

The ability or inability to taste the bitterness of the phenyl thiocarbamide (PTC) substance is one of the most important genetic markers that study human evolution and adaptation to different environments, as well as to study its effect on dietary habits associated with some important food-related diseases (Shivaprasad et al., 2012; Campbell et al., 2013; Tepper et al., 2014; Choi, 2014; Shen et al., 2016; Tepper et al., 2017; Yamaki et al., 2017).

Depending on the phenotypic pattern of PTC tasting, humans were divided into two main groups, either tasters or non-tasters. These patterns were inherited as a simple Mendelian trait with two alleles one of them (T) have a complete dominance over the other (t) (Fox, 1932; Blackslee & Fox, 1932). There was a gradual quantitative variation in the sensitivity of tasting this substance. According to this variation individuals were classified as; super tasters, medium tasters and non-tasters (Bartoshuk et al., 1994). At the molecular level, the inheritance of this trait was found to be due the presence of a major locus gene called \( \text{TAS2R38} \) (TAS = TASTE, Family = 2, \( R = \) receptors, Member: 38), which is responsible for the taste of PTC and a number of other similar substances (containing N-C=S moiety such as 6-n-Propylthiouracil (Prop)) (Kim et al., 2003). Two major common forms of haplotypes were detected: PAV for tasting and AVI for not tasting. With a number of intermediate and rare patterns found in some population (Campbell et al., 2012; Wooding et al., 2006).

The inherited sensitivity of tasting PTC and similar substances may contribute to the observed variability of individuals in their food intake habits and dietary behavior toward some types of fruits and vegetables (Dotson et al., 2010; Drewnowski et al., 2001; Shen et al., 2016). Consequently, these differences will impact their susceptibility of infection with some important related - food diseases of human (Timpson et al., 2005; Dotson et al., 2008; Turner-McGrievy et al., 2013; Choi, 2014).

Many researchers had studied the relationship of this trait with some diseases (Timpson et al., 2005; Shivaprasad et al., 2012; Choi, 2014; Shafaie et al., 2015; Yamaki et al., 2017; Burgess et al., 2017; Yildiz et al., 2016), including dental caries disease.

Dental caries is a multifactorial disease represents one of the major public health problems (WHO, 2017). It is caused by a combination of different genetic, as well as environmental factors (Opal et al., 2015; Yildiz et al., 2016; Lips et al., 2017; Weber et al., 2018). Many genes may influence the development of the risk of the disease (Shimizu et al., 2012; Renuka et al., 2013; Ergoz et al., 2014; Opal et al., 2015; Duverger et al., 2014; Morrison et al., 2016; Kong et al., 2017).

Some studies have suggested that there may be a relationship between the phenotypic patterns of PTC tasting and tooth decay, especially among children in the school age (Chung, 1963; Rupesh & Nayak, 2006) and this trait could be used as a sign of early childhood caries (ECC) diagnosis (Furquim et al., 2010; Hedge & Sharma, 2008). At the molecular level, this relationship had been studied (Wendell et al., 2010); the results showed that people with the genotype AVI may be more likely to develop tooth decay than the PAVs who may be more protected. Some subsequent studies on the basis of molecular analysis failed to confirm this association (Weber, 2016; Weber et al., 2018).

Different immunity response had been found among different types of both genotypes of tas2r38 (PAV, AVI) against bacteria causes respiratory infections (Lee & Cohen, 2013; Lee & Cohen, 2014; Adappa et al., 2016; Lu et al., 2017) and cariogenic bacteria (Gil et al., 2015), which opened a new era to the potential for the pathogenic-related biological functions of this trait (Viswanathan, 2013; Verbeurgt et al., 2017).

The current study aims at finding out the relationship between the taste of PTC with a genetic basis and tooth decay in a sample of primary and secondary students in Qurna and Madiana population, north of Basrah/Iraq.

2. Materials and Methods

2.1 The Studied Sample

The study was conducted in the city of Qurna and Madiana north of Basrah/Iraq on a sample of (406) individuals of the primary and secondary school’s students from both sexes’ males and females; ages ranged between (6-17)
years old. The sample was divided into two age groups: primary (6-12) y and secondary education (13-17) y.

2.2 Dental Caries Assessment

For caries diagnosis; DMFT (Number of decayed, missed, filled tooth) incidence were used (WHO; Mulic et al., 2012; Sovik et al., 2014). The severity of caries was counted into three sections: low, high and very high depending on the number of the observed dmft/DMFT: (1-3), (4-6) and 7 or more respectively (Weber, 2016; Feng et al., 2014). We excluded all teeth losing for any other reason than caries (WHO, 2003).

2.3 Measurement of PTC Taste Sensitivity

2.3.1 PTC Sensitivity Test Papers

Thirteen graduated concentrations of PTC were prepared by dissolving 0.13g of this substance in 100ml of boiling distilled water to prepare Solution No.1, which is the highest concentration, followed by a series of gradual dilutions until solution No.13 (Harris & Kalmus, 1949). Filter papers impregnated in each concentration numbered (1-13) and the boiling water as a control. The filters were lifted to be fully saturated; then dried and cut into small pieces, after their drying it was used to measure the sensitivity of tasting PTC substance (Ashly, 1960).

2.3.2 PTC Taste Sensitivity Test

The threshold score for PTC taste sensitivity was determined by; first asking every individual to wash his/her mouth with fresh water to avoid any prior bitter or other taste, Then, he/she started to taste filter paper as a control followed by PTC test paper and so on begging from the lowest concentrations grade No.13 up to the next higher concentration and so on towards the highest concentration (sol. No.1); till the individual felt bitterness, This degree of PTC sensitivity was recorded as his/her threshold No. The individuals who did not taste all the solutions up to (sol. No.1) were considered as having (0) score.

2.3.3 Phenotypic Classes of PTC Tasting

Phenotypic class of PTC tasting trait were determined depending on the critical binomial distribution. The anti-mode point was used to the classification of individual as tasters or non-tasters (Bartoshuk et al., 1994; Omari, 1986).

2.4 Statistical Analysis

The frequency of each PTC phenotypic class was calculated. The chi-square test was used to determine significant differences between different classes and groups. P value 0.05 was assigned as a significant level. Statistical packages IBM SPSS (version 22, 2013) was used for all statistical analysis.

3. Results

Table 1; Figure 1 shows the proportion of tasters and non-tasters in the primary stage. The percentage of tasters’ phenotype (82.6%) (66.6%), increased as compared to non-tasters (17.3) (33.3) among males and females respectively. Statistical analysis showed significant differences between the two gender (p ≤ 0.05).

In general, the proportions of tasters and non-tasters among the total number of primary school students were (74.4%) (25.6%) respectively.

Table 1. Proportions of PTC tasters and non-tasters among males and females students of primary school

<table>
<thead>
<tr>
<th>Gender *</th>
<th>Total No.</th>
<th>Tasters No.</th>
<th>Tasters Percent %</th>
<th>Non-tasters No.</th>
<th>Non-tasters Percent %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>121</td>
<td>100</td>
<td>82.6</td>
<td>21</td>
<td>17.3</td>
</tr>
<tr>
<td>Females</td>
<td>129</td>
<td>86</td>
<td>66.6</td>
<td>43</td>
<td>33.3</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
<td>186</td>
<td>74.4</td>
<td>64</td>
<td>25.6</td>
</tr>
</tbody>
</table>

*Significance \( [\chi^2 = 10.16, df=1, (p \leq 0.05)] \)
Regardless of PTC tasting status (tasters or non-tasters); caries as compared to non-caries individuals recorded a high prevalence of caries in primary school’s students among both: males (65.2) (Table 2) and females (70.5) (Table 3) respectively. females were more susceptible to have caries than males. However, this elevation had no significant power. According to PTC tasting phenotypes and caries prevalence; statistical analysis showed no significant differences (p > 0.05) between tasters (65) (72.1) and non-tasters (66.6) (67.4) from both males and females respectively.

Table 2. Prevalence of caries among tasters and non-tasters of PTC substance in primary school’s students/males

<table>
<thead>
<tr>
<th>Phenotype*</th>
<th>Total No.</th>
<th>Caries (dmft/DMFT)</th>
<th>No-caries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Percent %</td>
<td>No.</td>
<td>Percent %</td>
</tr>
<tr>
<td>Non-tasters</td>
<td>21</td>
<td>14 66.6</td>
<td>7</td>
<td>33.3</td>
</tr>
<tr>
<td>Tasters</td>
<td>100</td>
<td>65</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
<td>79 65.28</td>
<td>42</td>
<td>43.72</td>
</tr>
</tbody>
</table>

*not significance \( \left( x^2 = 0.0126 \text{ df}=1, (p > 0.05) \right) 

Table 3. Prevalence of caries among tasters and non-tasters of PTC substance in primary school’s students/females

<table>
<thead>
<tr>
<th>Phenotype*</th>
<th>Total No.</th>
<th>Caries (dmft/DMF)</th>
<th>No-caries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Percent %</td>
<td>No.</td>
<td>Percent %</td>
</tr>
<tr>
<td>Non-tasters</td>
<td>43</td>
<td>29 67.44</td>
<td>14</td>
<td>32.56</td>
</tr>
<tr>
<td>Tasters</td>
<td>86</td>
<td>62 72.1</td>
<td>24</td>
<td>27.9</td>
</tr>
<tr>
<td>Total</td>
<td>129</td>
<td>91 70.5</td>
<td>38</td>
<td>29.5</td>
</tr>
</tbody>
</table>

* not significance \( \left( x^2 = 0.308 \text{ df}=1, (p > 0.05) \right) 

A comparison of caries severity among tasters and non-tasters of PTC substance in primary school students from both sexes; males (Table 4) and females (Table 5) revealed a different mode of caries severity distribution among tasters and non-tasters from both sexes; it seems that the gender may have an effect on the relation of PTC tasting and caries severity; Non tasters males seems to be more susceptible to infect by low caries severity (85.7%) as compared to tasters (67.6%) with no significance differences (p > 0.05); while the opposite were recorded in females ;Tasters had a high proportion of low caries severity (80.64%) as compared to non-tasters (58.6%). These differences were very close to be statistically significant \( \left( x^2 = 5.133 \text{ df}=2, (0.10 > p < 0.05) \right) 

As a total; PTC tasters and non-tasters of PTC substance in primary school’s students had no significance differences \((p > 0.05)\) between them according to their caries severity distribution (Table 6).
Table 4. Caries severity among tasters and non-tasters of PTC substance in primary school’s students/males

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Total No.</th>
<th>Caries severity (dmft/DMF) No. (%)</th>
<th>Very high 7 ≥</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low (1-3) tooth</td>
<td>High (4-6) tooth</td>
</tr>
<tr>
<td>Non-tasters</td>
<td>14</td>
<td>12(85.7)</td>
<td>2(14.2)</td>
</tr>
<tr>
<td>Tasters</td>
<td>65</td>
<td>44(67.6)</td>
<td>16(24.6)</td>
</tr>
<tr>
<td>Total</td>
<td>79</td>
<td>56(78.8)</td>
<td>18(22.7)</td>
</tr>
</tbody>
</table>

*Non-significance \([x^2 = 1.99 \ df=2, \ (p > 0.05)\]  

Table 5. Caries severity among tasters and non-tasters of PTC substance in primary school’s students/females

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Total No.</th>
<th>Caries severity (dmft/DMF) No. (%)</th>
<th>Very high 7 ≥</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low (1-3) tooth</td>
<td>High (4-6) tooth</td>
</tr>
<tr>
<td>Non-tasters</td>
<td>29</td>
<td>17(58.6)</td>
<td>10(34.4)</td>
</tr>
<tr>
<td>Tasters</td>
<td>62</td>
<td>50(80.6)</td>
<td>10(16.1)</td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>67(73.6)</td>
<td>20(21.9)</td>
</tr>
</tbody>
</table>

*[(x^2 = 5.133 \ df=2, \ (0.10 > p < 0.05)\].

Table 6. Caries severity among tasters and non-tasters of PTC substance in primary school’s students/females & males

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Total No.</th>
<th>Caries severity (dmft/DMF) No. (%)</th>
<th>Very high 7 ≥</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Low (1-3) tooth</td>
<td>High (4-6) tooth</td>
</tr>
<tr>
<td>Non-tasters</td>
<td>43</td>
<td>29(58.6)</td>
<td>12(24.8)</td>
</tr>
<tr>
<td>Tasters</td>
<td>127</td>
<td>94(55.2)</td>
<td>26(29.4)</td>
</tr>
<tr>
<td>Total</td>
<td>170</td>
<td>123(72.3)</td>
<td>38(22.3)</td>
</tr>
</tbody>
</table>

*Not significance \([x^2 = 1.008 \ df=2, \ (p > 0.05)\]  

Table 7. Prevalence of caries among tasters and non-tasters of PTC substance among secondary school’s students/females & males

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Total No.</th>
<th>Caries (DMFT)</th>
<th>No-caries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. %</td>
<td>No. %</td>
</tr>
<tr>
<td>Non-tasters</td>
<td>54</td>
<td>28 51.8</td>
<td>26 48.2</td>
</tr>
<tr>
<td>Tasters</td>
<td>102</td>
<td>62 60.7</td>
<td>40 39.2</td>
</tr>
<tr>
<td>Total</td>
<td>156</td>
<td>90 57.6</td>
<td>66 42.3</td>
</tr>
</tbody>
</table>

*not significance \([x^2 = 1.151 \ df=1, \ (p > 0.05)\]  

At secondary stage; students had also a high prevalence of caries (57.6) (Table 7). There were no significant differences between males and females according to their PTC tasting status (p > 0.05). However, the results of this sample showed that there was a significance difference in the prevalence of caries between the primary and secondary students according to their ages; as it increased at the age group (6-12) years of primary school compared to the age group (13-17)years of the secondary school’s students (Table 8).

Table 8. Comparison of caries prevalence among primary and secondary students

<table>
<thead>
<tr>
<th>Age group(y)</th>
<th>Total No.</th>
<th>Caries</th>
<th>No-caries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. %</td>
<td>No. %</td>
</tr>
<tr>
<td>6-12</td>
<td>250</td>
<td>170 68</td>
<td>80 32</td>
</tr>
<tr>
<td>13-17</td>
<td>156</td>
<td>90 57.6</td>
<td>66 42.3</td>
</tr>
<tr>
<td>Total</td>
<td>406</td>
<td>260 64.03</td>
<td>146 36.4</td>
</tr>
</tbody>
</table>

* Significance \([x^2 = 4.616 \ df=1, \ (p ≤ 0.05)\]
4. Discussion

Dental caries refers to dental decomposition and is the result of long-term exposure to a low acidity arising from the fermentation of carbohydrates found in the mouth by several types of bacteria. Caries can influence our quality of life and nutrition (Peres et al., 2016).

Tooth decay is a complex disease with multiple causes and is still prevalent in all countries of the world despite the use of many preventive applications (WHO, 2003).

No correlation was found between PTC taste perception phenotypes (tasters and non-tasters) and dental caries among school children of primary and secondary school’s students in Qurna and Madaina population/Basrah/Iraq. The PTC taste perception may have an effect on dental severity in females while no such effect was found in males.

Tooth decay is a major global health problem and is estimated to affect or affect about 60-90% of school children and many adults (Weber, 2016; Dye et al., 2015). The causes of tooth decay in children appear to be different from those in the permanent teeth of adults (Wang et al., 2010), and women are more likely to be infected than men (Ferraro & Vieira, 2010; WHO, 2003). The level of caries is higher for the primary dentition than the permanent dentition for children of several developing countries in Asia and Africa (WHO, 2017). It is possible that the association of TAS2R38 with caries in the primary dentition may reflect biological processes that change with age, a greater influence of social and cultural influences on adult habits, or a combination of both, and could be explained by age-related processes (Wendell et al., 2010).

Recent studies have shown that human caries is a multifactorial disease and that there were many genes that may share the rate of infection, some of these, were directly related to the formation of teeth while others are not (Shuler, 2001; Shaffer, 2011; Shaffer, 2013; Renuka et al., 2013; Abbasoğlu et al., 2015; Kong et al., 2017; Weber et al., 2018).

The results of the current study indicate that there was a significant difference in the prevalence of tooth decay according to the age and gender; children aged 6-12 were the most vulnerable to infect with this disease while females were more infected than males. Many environmental factors as well genetic factors may play a role in these differences; Perhaps the most important reason is that children of primary age were more prone to eat sweets and sugars, and their teeth are weak and will prone to decay (Anilker et al., 1991; Drewnowski et al., 2001; Abbasoğlu et al., 2015). In the other hand secondary school’s students might have an increase in health awareness and be more attention to oral hygiene; also eating sweets in secondary ages is less than in primary ages, or their immunity system is mature and more effective than in childhood; Besides expression of some genes may differ between these two ages (Wang et al., 2010) or could be by all the mentioned above. Differences in hormonal constitution, immunity response could explain the variation of caries infection in both gender where females seem to be more affected than males (Lukacs, 2007; Ferraro & Vieira, 2010; Lukacs, 2011; Loper et al., 2015; Joseph et al., 2016).

Dental caries thought to be a dietary-related disease, children’s dietary habits largely influence their risk of developing caries. Children are thought to like sweets more than adults and a high preference of sugar among children has been reported (Drewnowski, 2000; Mennella & Bobowski, 2015).

Many researches recorded a correlation of PTC sensitivity with some foods and other sensation of: sweet, salty bitter taste (Akella et al., 1998; Anilker et al., 1991; Keller et al., 2002; Keller et al., 2014; Joseph et al., 2016).

Some studies indicate that non-tasters were more likely to have tooth decay than those who were tasters (Furquim et al., 2010; Pidamale, 2012), Chung (1965) noted this relationship between pre-school and non-adult age groups. Wendell et al. (1990) found that AVI/AVI genotype have been more susceptible to have caries and explained this by food habits and food preferences, which in turn will affect the development or prevention of the emergence of tooth decay. Yildiz et al. (2016) found that many environment and genetic factors including T4S2R38 (A49P), and CA6 (T55M) gene polymorphism, interact with each other and explained a total of 87.8% of the variations in DMFT scores in Turkish adults. However, this relation with PTC tasting trait or its association with certain age groups and not with others (Shaffer et al., 2013) is still controversial since some studies confirm it while others were not (Weber, 2016; Weber et al., 2018; Yildiz et al., 2016).

Molecular studies have shown a difference in the immunity response of both tasters and non-tasters to different types of cariogenic bacteria (Gil et al., 2015) and others (Farquhar et al., 2015; Verbeurt et al., 2017). There are a variety of variations in genes associated with a high or low incidence of tooth decay (Piekoszewska-Ziętek et al., 2017); Thus, Dental caries is a multi-factorial disease and cannot be limited to only one factor or gene (Weber, 2016). The current study, although not confirm this relation in this sample, suggests that the presence or
compatibility of a number of environmental and genetic factors may shape this association, including a variety of genes, for example, it was found that the heterozygote genotypes of TAS2R38 gene were associated with certain genetic patterns of CA6-encoded carbonic anhydrase 6; an enzyme important in regulating pH capacity of saliva, which in turn affects the degree of tooth consistency and non-erosion when saliva buffer capacity is low (Li et al., 2015; Melis et al., 2018; Esberg et al., 2019) So, the genetic makeup of an individual from many genes and differences in expression of these genes may affect this relation or explain it.

5. Conclusion

In conclusion caries is more complicated disease than it appears and that the subject still needs many of the future studies. These studies included all the consensus of what has been proven impact. In addition, the appearance of the two phenotypes of PTC taste may be due to the involvement of other genes, not only the appearance of the PTC gene, including CA6 gene (Yildiz et al., 2016; Melis et al., 2018), which in turn affects the pH capacity of the saliva, a factor associated with tooth decay (Esberg et al., 2019). Due to the multifactorial nature of dental caries, the individual’s vulnerability may differ from one another where some may be more susceptible to a higher risk of developing the disease. In addition, particularly regarding diet, part of the strategy to be adopted can be defined as health promotion by preventing the occurrence of the disease rather than treatment. Integrating a healthy dietary regimen into the daily routine can have a real influence on oral health and can be regarded as a primary step towards caries prevention.

Acknowledgements

I would like to thank Professor Dr. Asaad Y. Ayied, College of agriculture/Basrah University for his great assistance and help in writing and data analyzing. Also, my great thanks to my ex colleagues Dr. Ibtissam Kareem and Dr. Afrah/college of dentistry/Misssan University for their support and help in laboratory preparations.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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