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Abstract

Background: Dietary intake of fat, salt and sugar is important for prevention of noncommunicable diseases; therefore, evaluation of these constituents in industrial packaged foods is necessary.

Aims: To compare the levels of fat, salt and sugar in mayonnaise and salad dressings commercialized in the Islamic Republic of Iran in 2017 and 2019, and to monitor compliance with standard limits.

Methods: The levels of fat, salt and sugar in 12 mayonnaise and 47 salad dressing samples collected from an Iranian market were evaluated according to the Iranian Institute of Standards and Industrial Research of Iran (ISIRI) and compared between 2017 and 2019.

Results: We determined compliance with ISIRI limits and other standard targets. The salt content of mayonnaise samples significantly decreased from 2.03 (standard deviation; 0.3) g/100 g in 2017 to 1.61 (0.12) g/100 g in 2019 (P = 0.031). Total sugar level of mayonnaise samples significantly decreased from 5.97 (1.14) g/100 g in 2017 to 3.63 (0.53 g/100 g in 2019 (P = 0.005).The total sugar level of salad dressings significantly decreased from 8.97 (2.34 g/100 g in 2017 to 1.58 (2.65) g/100 g in 2019 (P = 0.039). Compliance of mayonnaise and salad dressing fat contents with ISIRI limits increased from 42.9% and 84.6% in 2017 to 100% and 90.5% in 2019, respectively. None of the mayonnaise samples met the British Food Standards Agency salt target (maximum 1.25 g/100 g) in 2017 and 2019.

Conclusions: Reformulation of these products for reduction of salt and sugar content is necessary.

Keywords: mayonnaise; salad dressing; fat; salt; sugar

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Introduction

Noncommunicable diseases (NCDs) such as cardiovascular diseases and diabetes are major concerns in industrialized countries (1) and were responsible for 82% of deaths in the Islamic Republic of Iran in 2016 (2). There is a link between dietary intake of fat, salt and sugar and NCDs (3–6). Trans and saturated fatty acids are a major cause of coronary heart disease (7). Excessive salt intake is related to risk of high blood pressure and cardiovascular diseases (5), which are responsible for 43% of mortality in the Islamic Republic of Iran (2).The World Health Organization (WHO) recommends a maximum daily intake of salt of 5 g for adults (8); however, the average intake in the Islamic Republic of Iran was 10 g/day in 2016 (2). The highest daily intake of sodium for women (3.9 g/day) in the Eastern Mediterranean Region was reported in the Islamic Republic of Iran (9). Consumption of foods containing high amounts of sugar increase the risk of dental caries (10). There is also a direct relationship between sugar intake in sweet drinks and diabetes (3,4).

Nutritional status is one of the important causes of NCDs. Therefore, WHO implemented a global action plan for prevention of NCDs in 2004 and reduction of salt, sugar and saturated fatty acid levels, and elimination of trans fatty acids in commercial food products are emphasized. The global aims of 30% reduction in salt intake by 2025 and halting the increase in diabetes and obesity were set by WHO (11). Eighty-three countries have salt-reduction strategies and 59 have aimed to reduce salt in commercial foods by establishing voluntary and mandatory targets, industry meetings, and reformulation. The Islamic Republic of Iran is one of the countries that is aiming to reduce salt intake by working with the food industry for reformulation of foods (12).

Mayonnaise, an oil-in-water emulsified semisolid food product, is prepared from vegetable oil, acidifying agent, egg yolk and optional components such as mustard and spices (13). Salt can contribute to product flavour and promote emulsion stability (14). It also helps to disperse the granules of egg yolk, which can improve surface active material. By neutralization of charges on proteins, salt allows them to adsorb to the existing layer on oil droplets. Too much salt can aggregate egg yolk proteins in aqueous phase by dehydrating them. Sugar can limit gelation of egg yolk, as well as being a flavouring agent (15). Compared to mayonnaise, which contains 60–80% oil, salad dressing has

The objectives of this study were to compare total fat, salt and sugar levels of commercial mayonnaise and salad dressing in the Islamic Republic of Iran in 2017 and 2019, and to monitor compliance with ISIRI standards.

Methods

Study design

This was a cross-sectional study and part of a national programme on monitoring the salt, fat, sugar, and saturated and trans fatty acid content in commercial and traditional food products in

the Islamic Republic of Iran.

Sample collection

A total of 12 mayonnaises and reduced-fat mayonnaises and 47 salad dressing samples from 11 brands were collected from supermarkets in Tehran Province in 2017 and 2019. Salad dressing samples include French, thousand island, sandwich and other salad dressings (yoghurt, cheese and garlic, lemon and mild mustard dressings). The purchased samples were kept in the refrigerator and tested before the expiration date. All chemicals and solvents were of analytical grade and used without further purification. The salt, total fat and sugar levels of the samples were determined in triplicate according to the ISIRI methods (13,27).

Determination of salt

For determination of salt content, 25 ml 0.1 N $AgNO_3$ and 2 ml concentrated nitric acid were added to 3 g of sample. The solution was made up to 100 ml with distilled water and filtered. After addition of 2 ml $FeNH_4(SO_4)_2$ 12 H_2O to 50 ml filtrate, titration by NH_4SCN was conducted until the first appearance of a red–brown colour. Percentage of salt was calculated on the basis of the volume of NH_4SCN used and the volume of $AgNO_3$ (27).

Determination of fat

Total fat levels of the samples were determined by the Gerber method using butyrometer according to the Iranian national standards (13,28).

Determination of sugar

For determination of total sugar, about 1 g active carbon was added to 26 g homogenized sample and the volume was made up to 100 ml and filtered. Twenty-five millilitres of filtrate was transferred to a 100-ml round-bottom flask and 10 ml concentrated hydrochloric acid and 10 ml distilled water were added to the filtrate. For the hydrolysis step, the flask was rotated for 3 minutes and static for 7 minutes in a 60–70 water bath. The flask was cooled in a beaker containing cold water; a few drops of phenolphthalein were added and the filtrate was neutralized by NaOH. After recooling, the flask was made up to 100 ml and neutralized filtrate was refiltered. While heating, the refiltrate was titrated using 5 ml Fehling's A and 5 ml Fehling's B solutions and 1–2 ml methylene blue with a few pearls and distilled water (27).

The measured fat content was compared with the maximum fat content limits set by ISIRI for mayonnaise (65 g/100 g), reduced-fat mayonnaise (40–50 g/100 g) and salad dressings (36–56 g/100 g) (13). No standard limits were determined by ISIRI for salt and total sugar. Therefore,

the measured salt contents were compared with the maximum salt targets for 2017 of the United Kingdom of Great Britain and Northern Ireland (UK) Food Standards Agency (FSA) for mayonnaise (1.25/100 g), reduced-fat mayonnaise (1.7 g/100 g) and salad dressings (1.5 g/100 g) (29) and the maximum sodium targets of the Federal Commission for Protection against Health Risks (COFEPRIS) for mayonnaise (750 mg/100 g) (21). After changing the units of the sodium target from mg/100 g to g/100 g, they were converted to salt by multiplying by 2.54 in order to become comparable with the measured salt content of our study.

Statistical analysis

The data are shown as the mean (standard deviation) of triplicate determinations and analysed by independent sample t test, one-way analysis of variance and one sample t test using SPSS version 21 (SPSS Inc./IBM Corp., Chicago, IL, USA). $P \leq 0.05$ was considered significant.

Results

In the present study total fat, salt and sugar levels of 59 mayonnaise and salad dressing samples were evaluated in 2017 and 2019. In 2017, the samples included 7 mayonnaises and reduced-fat mayonnaises and 26 salad dressings. In 2019, 5 mayonnaises and reduced-fat mayonnaises and 21 salad dressings were tested.

Mayonnaise

The mean levels of total fat did not differ significantly between 2017 and 2019 in any of the mayonnaise samples (Table 1). The salt content of mayonnaise samples was significantly reduced from 2.03 (0.3) g/100 g in 2017 to 1.61 (0.12) g/100 g in 2019 (P = 0.031) (Table 2). As shown in Table 3, total sugar level of mayonnaise samples was significantly reduced from 5.97 (1.14) g/100 g in 2017 to 3.63 (0.53)g/100 g in 2019 (P = 0.005) (Table 3).

Salad dressings

The total fat levels did not differ significantly between 2017 and 2019 in any of the salad dressing samples

(Table 1). The salt content of salad dressings in 2019 [1.86 (0.39) g/100 g] did not differ significantly from that in 2017 [2.07 (0.37) g/100 g] (Table 2). Total sugar level of salad dressings was significantly reduced from 8.97 (2.34) g/100 g in 2017 to 7.58 (2.05) g/100 g in 2019 (P = 0.039)

(Table 3). A similar significant reduction was observed for total sugar level of other salad dressings between 2017 and 2019 (P = 0.038).

Compliance with standard limits

Compliance of mayonnaise and salad dressing samples with ISIRI limits was 42.9% and 84.6% in 2017, respectively, which increased to 100% and 90.5% in 2019 (Table 4).

As there is no ISIRI limit for the salt and total sugar contents of mayonnaise and salad dressing, we compared the salt content of our samples with the targets established by the UK FSA and COFEPRIS. Although none of the salt contents of the mayonnaise samples was compatible with the UK FSA targets (maximum 1.25 g/100 g), 33.3% and 100% of the mayonnaise samples were compatible with COFEPRIS in 2017 and 2019, respectively (Table 5). For salad dressings, 11.5% and 23.8% of samples were in accordance with UK FSA salt targets (maximum 1.5 g/100 g) in 2017 and 2019, respectively.

Total fat levels of mayonnaise samples in 2019 [58.36 (14.12) g/100 g] and 2017 [51.0 (13.59) g/100 g] were not in accordance with the ISIRI limit (≥ 65 g/100 g). However, the difference between mean total fat and standard limits was not significant in 2017 (P = 0.053) and 2019 (P = 0.416). The salt content of mayonnaise samples in 2017 [2.03 (0.3) g/100 g] (P = 0.001) and 2019 [1.61 (0.12) g/100 g] (P = 0.010) significantly exceeded the UK FSA target (maximum 1.25 g/100 g). Although mean salt content in 2017 was higher than the COFEPRIS target (1.91 g/100 g), the difference was not significant (P = 0.382). The mean salt content in 2019 was significantly below the COFEPRIS target (P = 0.017).

Total mean fat levels of salad dressing samples were in accordance with the ISIRI limit (36–56 g/100 g) in 2017 [40.38 (8.84) g/100 g] [95% confidence interval (CI): 36.81–43.95%] and 2019 [38.93 (9.86) g/100 g] (95% CI: 34.44–43.42%). The mean salt content of salad dressing samples in 2017 [2.07 (0.37) g/100 g] and 2019 [1.86 (0.39) g/100 g] significantly exceeded the UK FSA target for 2017 (maximum 1.5 g/100 g) (P **Discussion**

In the current study, total fat levels of mayonnaise samples in 2017 and 2019 were approximately twice those of mayonnaise samples (30.76 g/100 g) in a study of 6 brands in Malaysia (25). In the current study, the salt content of mayonnaise samples in 2019 were significantly reduced in comparison with samples in 2017. In a study of salt content of foods over a 5-year period (2011–2016) in the Netherlands, the average salt content of 15 samples of 6 brands of emulsion-based sauces collected from local supermarkets was 8% lower compared to the average in 2011, but this reduction was not significant (24). The salt content of our

mayonnaise samples in 2017 and 2019 was lower than the sodium content of mayonnaise (868.9 mg/100 g or 2.21 g/100 g salt) and reduced-fat mayonnaise (751.7 mg/100 g or 1.91 g/100 g salt) in Mexico (21) and higher than the sodium content of mayonnaise [603.6 (54.38) mg/100 g or 1.53 (0.14) g/100 g salt) in Malaysia (25). In the current study, total sugar levels of mayonnaise samples in 2017 and 2019 were lower than those of mayonnaise samples [8.59 (1.20) g/100 g) in Malaysia (25).

In our study, total fat levels of salad dressing samples in 2017 and 2019 were higher than those of salad dressing samples (29.85 g/100 g) obtained in 6 different mayonnaise and salad dressings brands in Malaysia (25). The salt content of salad dressing samples in 2017 and 2019 was lower than that salad dressing samples in Malaysia [848.67 (96.92) mg/100 g or 2.16 (0.25) g/100 g salt] (25) and Argentina (1493.4 mg/100 g or 3.79 g/100 g salt) (17). Moreover, in monitoring sodium content of processed food in Argentina, dressings were one of the categories within the sauces and spreads group with the highest median sodium content (950 mg/100 g, 2.41 g/100 g salt). The total sugar levels of salad dressing samples in 2017 and 2019 were lower than those in salad dressing samples [15.47 (2.40) g/100 g] in Malaysia (25).

Although, the salt contents of none of the mayonnaise samples were compatible with the UK FSA targets (maximum 1.25 g/100 g), 33.3% and 100% of the samples were compatible with COFEPRIS in 2017 and 2019, respectively. Accordingly, the sodium levels of none of the mayonnaise samples in Mexico met the UK FSA targets. However, 59% of the samples were in accordance with COFEPRIS (21). In a study conducted in Argentina based on the nutritional facts on the labels, none of the mayonnaise samples was above the regional sodium target for 2015 (1050 mg/100 g or 2.67 g/100 g salt) and 97.1% were above the lower sodium target (670 mg/100 g or 1.7 g/100 g salt) (17). In recent years there has been a focus on producing reduced-fat and low-cholesterol mayonnaise and salad dressings in different ways, such as using fat substitutes or replacing fat with other natural ingredients (30, 31). Moreover, the impact of food taxation on reduction of sugar, salt and fat in commercial food products has been studied in several countries such as Denmark, United States of America, and Germany, confirming the WHO recommendations for governments using fiscal policies to promote healthy diets in the population (32–35).

Conclusion

Considering the increase in compliance with ISIRI limits for fat content between 2017 and 2019, the results of the current study seem satisfactory. Although there was a significant reduction in salt and sugar contents of mayonnaise and sugar content of salad dressings from 2017 to 2019, none of the mayonnaise samples met the UK FSA salt targets in either year. Therefore, reformulation of these products for salt reduction is necessary. It is recommended that standard limits for salt and sugar levels in mayonnaise and salad dressings be determined by ISIRI.

The current study was part of a national programme on monitoring nutritional risk factors for NCDs in Iranian food products, and a limited budget was allocated to the study of mayonnaise and salad dressings. The studied samples were well-known and highly consumed brands available in chain stores and supermarkets in Tehran, and did not include less-popular brands with low levels of production that were sold locally and not transported from other cities to Tehran. Therefore, our results are not completely representative of all mayonnaise and salad dressings retailed in the Iranian market. Unlike most other studies, which relied on food labelling, our results were based on chemical analysis of the samples, which was closer to the actual levels of the measured constituents. Future studies covering a wider range of brands and increased sample size will be useful. Moreover, the results of the current study may be used for updating the Iranian Food Composition Table. Generally, food product reformulation, introducing taxes on food and drinks containing high levels of sugar, salt or fat, setting standard limits, suitable methods of food labelling, and health education are effective ways of reducing the risk of NCDs.

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Étude comparative des teneurs en sel, en graisses totales et en sucre de la mayonnaise et des sauces pour salade du marché iranien

Résumé

Contexte : L’ apport alimentaire en graisses, en sel et en sucre est important pour la prévention des maladies non transmissibles ; il est donc nécessaire d’évaluer ces constituants dans les aliments industriels emballés.

Objectifs : Comparer les niveaux de graisse, de sel et de sucre dans la mayonnaise et les sauces pour salade commercialisées en République islamique d'Iran en 2017 et 2019, et surveiller le respect des limites standard.

Méthodes : Les niveaux de graisse, de sel et de sucre dans 12 mayonnaises et 47 échantillons de sauces pour salade collectés sur un marché iranien ont été évalués selon l'Institut iranien des normes et de la recherche industrielle (ISIRI) et comparés entre 2017 et 2019.

Résultats : Nous avons déterminé la conformité aux limites ISIRI et aux autres objectifs standard. La teneur en sel des échantillons de mayonnaise a sensiblement diminué, passant de 2,03 g/100 g (écart type ; 0,3) en 2017 à 1,61 g/100 g (0,12) en 2019 (p = 0,031). Le taux de sucre total des échantillons de mayonnaise a significativement diminué, de 5, 97 g/100 g (1,14) en 2017 à 3,63 g/100 g (0,53) en 2019 (p = 0,005). Le taux de sucre total des sauces pour salade a considérablement baissé, de 8,97 g/100 g (2,34) en 2017 à 1,58 g/100 g (2,65) en 2019 (p = 0,039). La conformité de la teneur en graisse de la mayonnaise et de la sauce pour salade aux limites ISIRI est passée de 42,9 % et 84,6 % en 2017 à 100 % et 90,5 % en 2019, respectivement. Aucun des échantillons de mayonnaise n'a atteint l'objectif fixé par la British Food Standards Agency pour le sel (au maximum 1,25 g/100 g) en 2017 et 2019.

Conclusions : Il est nécessaire de modifier la formulation de ces produits pour réduire la teneur en sel et en sucre.

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