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Article

Sodium content of processed foods available in the Mexican market

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Abstract: Background: Sodium intake has been related to several adverse health outcomes; such as, hypertension, and cardiovascular diseases. Processed foods are major contributors to the population's dietary sodium intake. The aim of the present study was to determine sodium levels in Mexican packaged foods; also to evaluate the proportion of foods that comply with sodium benchmark targets set by the UK Food Standards Agency (UK FSA) and those set by the Mexican Commission for the Protection of Health Risks (COFEPRIS). We also evaluated the proportion of foods that exceeded the Pan American Health Organization (PAHO) targets. Methods: This was a cross-sectional study that comprised data collected from the package of 2,248 processed foods from selected supermarkets of Mexico. Results: Many processed food categories contained excessive amount of sodium, being the processed meats (ham, bacon and sausages) those that have the highest concentrations. The proportion of foods classified as compliant in our sample was lower for international targets (FSA UK and PAHO) compared to the Mexican COFEPRIS criteria. Conclusions: These data provide a critical baseline assessment for monitoring sodium levels in Mexican processed foods.

Keywords: sodium; sodium targets; food industry; diet.

1. Introduction

Materials and Methods should be described with sufficient details to allow others to replicate and build on published Sodium intake has been related to several adverse health outcomes; such as, hypertension, cardiovascular diseases, and death [1–4]. In 2010, an estimated of 1.65 million of cardiovascular deaths in the world were attributed to a salt intake above the limit of 5 grams a day [3], being in some areas of the Americas the 9th to the 15th leading cause of premature death. In México, the prevalence of hypertension reached 31.5%[5] and cardiovascular diseases are the first cause of dead in the country[6]. The World Health Organization (WHO) recommends that the intake of salt should be less than 5 grams per day[7]. In 2013, the Global Action Plan for the Prevention and Control of Non-Communicable Diseases set a target to reduce the population intake of sodium by 30% [8]; since it has been suggested that the reduction of dietary sodium is one of the most cost-effective interventions to improve population health[9]. Due to the great influence that sodium has on the health of the population several countries have introduced strategies to reduce salt consumption including health promotion campaigns, taxes, food labelling, consumer education, and public health interventions [10][11]. In Mexico, some strategies like removing saltshakers form tables of restaurants and reducing sodium content in bread have been implemented [12,13].

Processed foods are major contributors to the population's dietary salt intake [14–17]; therefore, lowering sodium in packaged foods can be an important intervention to reduce population intakes. In Mexican population, the main dietary sources of sodium are breads, meats, pizzas, sandwiches, cheese, and some packaged foods such as soups, rice, and snacks[18]. A recent study found that ready to eat breakfast cereals are high in sodium content [19]. Since 36% of the total energy intake of the Mexican diet comes from processed and ultra-processed foods [20], an assessment of current sodium content is key to monitoring processed foods and encourage reformulation. Some institutions have been working in the establishment of targets in order to monitoring and evaluate the content of sodium in food groups. Those institutions are: the Food Standard Agency (FSA) in United Kingdom (UK), the Federal Commission for Protection against Health Risks (COFEPRIS, by its acronym in Spanish) in Mexico, and the Pan American Health Organization (PAHO) in the Pan-American region.

In this context the FSA established targets for 2017 aiming for further reduction of sodium content[21]. They also recognized the progress made by UK food industry in 2013; nevertheless, they acknowledge the potential of reducing the salt content in processed foods even more with the new targets[22]. In Mexico as a part of a policy package in Mexico to fight obesity and chronic diseases. The Mexican government, specifically COFEPRIS implemented a voluntary strategy for packaged foods. This voluntary legislation consisted in obtaining the nutritional stamp endorsed by the Ministry of Health if food manufacturers accomplish nutrients criteria. Such stamp aims to indicate if a product is healthy for regular consumption among the Mexican population. The legislation, approved by the Ministry of Health in 2014, established cut-off points regarding the maximum levels of energy, sodium, saturated fat and sugar allowed in commonly consumed foodstuff[23]. Finally, a consortium of governments, civil society, and food companies (the Salt Smart Consortium) agreed to a set of maximum targets (upper limits) for sodium levels for 11 food categories to be achieved by December of 2016. The technical advisory group (TAG) compiled their experiences and lessons learned into guidance on how to establish national initiatives that engage food companies to reformulate [24]. The food categories considered were: bread, soups, mayonnaise, biscuits and cookies, cake, meats, breakfast cereals, cheese, processed cheese products, and cheese spreads, butter/dairy spreads and margarine, snacks, pasta, and condiments.

To date Mexico does not have a monitoring system to evaluate the sodium content of processed foods. Less an assessment that shows compliance with international, regional and local targets. Thus, the main objectives of the study were to determine sodium levels in Mexican packaged foods; and to evaluate the proportion of foods that comply with sodium benchmark targets set by the UK FSA, and COFEPRIS. We also evaluated the proportion of foods that exceeded the PAHO targets.

2. Materials and Methods

2.1 Study design

This cross-sectional study comprised data collected from July to December of 2015. Data were collected from selected supermarkets of Mexico. A subsample of stores were selected from the census track of the most inhabited cities in the country. The number of stores selected in each cities depended on the population size of each city. The visited stores were supermarkets, and convenience stores. Those together represent approximately 70% of the Mexican market share[25]. All available food

products at the time in the stores' aisles were included. This sampling allowed an extensive coverage of available food products in Mexico. Photographs of the package and the labelling of processed foods were taken from eight main food retail chains in the country. The personnel who collected the data followed a standardized operation procedure according to Kanter et al.[26]. The staff were trained and standardized by researchers of the Mexican National Institute of Public Health[27]. Nutrition content information from photographs were captured into an excel spreadsheet. The fieldworker coordinator revised the completeness and accuracy of the data. The database included the following information: product name, brand, price, claims, serving size, nutrition content, and location of supermarket. In case of exact duplicates, the most recently entered product was used. Information from (n=2,248) food products was analyzed. Sodium content was recorded in mg per portion and then converted into mg/100 g. Food categories and subcategories were defined based on the FSA and on the PAHO criteria.

2.2 Ethical Approval

This study was evaluated and approved by the Research, Ethics and Biosafety Committees of the National Institute of Public Health of Mexico (ethical approval number: 1275). Before conducting the study, the research team asked for permission from the supermarket's manager to access the stores and take photos of processed foods available.

2.3 Statistical Analysis

The database was imported to STATA format to be cleaned. First, we identified outliers of the sodium content by each food category or subcategory. When an extreme value was found, we checked against photographs of processed products to see if the value was correct. Additionally, we randomly check the sodium content against the photographs of the products to ensure accuracy.
First, normal distribution of the variables was calculated. Mean and standard deviations of sodium content (mg/100 g) of food categories and subcategories were calculated. Percentiles were also calculated since most of the data was skewed. We calculated the proportion of compliant food products by the FSA benchmarks and COFEPRIS cut-off points when available. Differences in the proportion of compliant food categories and subcategories between the UK FSA targets and COFEPRIS criteria were explored using tests of proportions. For all the analyses significance was established when $p < 0.05$. All analyses were performed using STATA version 14 (StataCorp, College Station, TX, USA).

3. Results

This analysis included 2,248 food items from 12 food groups. **Table 1** shows the mean sodium content in mg per 100 grams. The food groups with the highest sodium content were: ham (1255.1 mg/100g), bacon (1027.4 mg/100g), sausages (883.9 mg/100g), reduced mayonnaise (868.9 mg/100 g), processed cheese (862.7 mg/100g), and mayonnaise (751.7 mg/100g). There was high variability in sodium levels across several product categories including: soups (220.0-5165.7 mg/100g), pasta (4.2-3480.0 mg/100g), and biscuits (4.0-2778.8 mg/100g). In contrast, there was less variability in the sodium content of standard potato crisps (400.0 to 560.0 mg/100g) and mozzarella cheese (303.64 to 674.0 mg/100g). Butter and cake had the lowest sodium content with 129.7 mg/100g and 263.1 mg/100g respectively.

Table 1. Sodium content of processed food groups and subgroups available in the Mexican market (mg/100 g) (N=2,248).

Food group	Subgroup	n	Min	Max	Mean	SD	p25	p50	p75
Meat products	Bacon*	21	90	2133	1027	585	600	1000	1318
	Ham	43	500	2900	1255	738	745	995	1580
	Sausages	82	70	1500	884	204	807	897	982
Bread		215	133	1500	552	215	390	447	616
Breakfast cereals	Breakfast cereals	404	0	1062	298	223	67	323	480
Cheese	Processed cheese	60	210	2667	863	421	600	780	1149
	Fresh cheese*	35	14	970	498	209	363	568	615
	Mozzarella*	17	304	674	510	147	360	570	643
Butter	Butter	40	0	740	130	231	0.7	9.02	198
Fat spreads	Margarine	22	400	920	586	182	440	530	735
	Mayonnaise	29	536	1250	752	218	570	625	932
	Reduced mayonnaise*	12	680	1200	869	139	757	883	913
Soups		84	220	5165	723	803	350	594	690
Pizzas		51	272	934	483	119	407	473	547
Crisp and snacks	Standard potato crisps*	5	400	560	464	88	400	400	560
	Extruded and sheeted snacks	234	41	2480	839	415	578	760	1000
	Salt and Vinegar products*	7	246	1045	572	273	389	520	821
Cakes		132	0	795	263	169	200	250	340
Biscuits		594	4	2778	297	206	162	276	388
Pasta		161	4	3480	804	827	74	643	1652

*Food groups or subgroups that had a normal distribution (p>0.05)

Processed foods in the Mexican market were also classified as compliant and non-compliant according to two profiling systems; the UK FSA targets, and the COFEPRIS criteria. Overall, 61% complied with COFEPRIS target; while only 32% of foods comply with the FSA target (**Figure 1**). In other words, food products that comply with COFEPRIS target were twice as those that complied with UK FSA criteria.

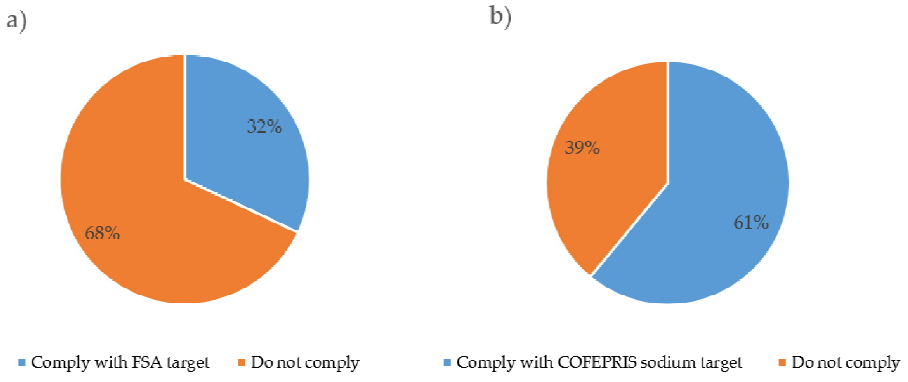

Figure 1. a) Proportion of packaged foods meeting and exceeding FSA's sodium benchmark targets. b) Proportion of packaged foods meeting and exceeding COFEPRIS's sodium targets (n–2,248).

Table 2 shows the proportion of packaged foods that comply with sodium targets from the UK FSA and COFEPRIS. The highest proportion of foods meeting the UK FSA targets were butter (93%),

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138 salt and vinegar crisps (71%), and bacon (62%); whereas mayonnaise (0%), reduced mayonnaise (0%),
139 and soups (2%) had the lowest compliance. On the other hand, the highest proportion of foods
140 meeting the COFEPRIS criteria were mozzarella cheese (100%), fresh cheese (94%), and butter (93%).
141 The lowest compliance were for sausages (22%), soups (24%) and ham (28%).
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Table 2. Proportion of packaged foods by food group and subgroup complying sodium targets of the FSA and COFEPRIS (N=2,248).

Food group	Subgroup	n	UK FSA target (mg/100g)	COFEPRIS target (mg/100g)	% of compliance with FSA target	% of compliance with COFEPRIS target	P value
Meat products	Bacon	21	1150	NA	62	NA	--
	Ham	43	650 (p)	800	14	28	0.5
	Sausages	82	650 (p)	800	7	22	0.4
Bread		215	360 (r)	500	14	61	0.001
Breakfast cereals	Breakfast cereals	404	235 (r)	500	37	78	0.001
Cheese	Processed cheese	60	650 (r)	800	32	58	0.06
	Fresh cheese	35	200 (r)	800	14	94	0.001
	Mozzarella	17	540 (p)	900	47	100	0.03
Butter	Butter	40	590 (r)	500	93	93	0.5
Fat spreads	Margarine	22	425 (r)	500	18	50	0.67
	Mayonaisse	29	500 (max)	750	0	59	--
	Reduced mayonaisse	12	680 (max)	NA	0	NA	--
Soups		84	210mg (r)	350	0	24	--
Pizzas		51	500 (max)	NA	57	NA	--
Crisp and snacks	Standard potato crisps	5	525 (r)	450	60	60	0.5
	Extruded and sheeted snacks	234	680 (r)	NA	40	NA	--
	Salt and Vinegar products	7	750 (r)	NA	71	NA	--
Cakes		132	170mg (r)	450	23	89	0.001
Biscuits		594	220 (r)	450	36	85	0.001
Pasta		161	200 (r)	500	40	64	0.01

FSA targets: There are two types of average used within the targets table. The first is a processing average (p) and is used to account for ranges of salt levels that occur in a single product e.g. bacon and tuna. The second is a range average (r) which is used to take account of a range of different flavours (e.g. standard potato crisps) or products (e.g. morning goods) covered by a single target. All range averages should be calculated on a sales weighted basis.

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3.1 Comparison UK FSA vs. COFEPRIS

From the 43 types of ham collected 14% complied with the UK FSA target (650 mg of sodium/100 g), while 28% complied with COFEPRIS (800 mg of sodium/100 g). Sausages faced a similar situation 7% complied with the FSA target and 22% complied with COFEPRIS. No statistically significant differences were found for those two subgroups ($p>0.05$) Among different kinds of bacons assessed, only 38% of different bacons are above the UK FSA target whereas COFEPRIS does not have a cut-off point. Bread had 14% of products complying with UK FSA targets compared to 61% complying with COFEPRIS criteria ($p<0.001$). For breakfast cereals 37% complied with UK FSA, while 78% complied with COFEPRIS ($p<0.001$). For mayonnaise and for reduced mayonnaise none of the products complied with the UK FSA target; while the proportion of mayonnaise that complied with the COFEPRIS criteria was 59%. The only food subgroup that had the same proportion of compliance for both targets was standard potato crisps (60%). Even though cakes had one of the lowest mean sodium content, only 23% complied with UK FSA target (170 mg of sodium/100 g) and 89% complied with COFEPRIS sodium criteria (450 mg of sodium/100 g) ($p<0.001$) (**Table 2**).

3.2 PAHO sodium reduction targets

Finally, **Table 3** shows the food categories and subcategories that exceed the regional and lower targets set by the PAHO. Soups were the category with the highest proportion above the regional target (73%), while butter complied the most with 100% of the regional target established by PAHO. Meats were the category with the highest proportion above the lower target (91%). Butter only had 8% above the lower target. Snacks and breads also had great proportions above the PAHO regional target, 35% and 29% respectively. Soups and snacks had great proportions above the lower target, (88% and 83%, respectively). The food categories that complied the most with the regional targets were: butter 100%, meats 98%, and breakfast cereals 96%. However, lower targets were harder to meet, being butter (92%), breakfast cereals (78%), and pasta (77%) who came closest to meet the targets.

Table 3. Proportion of food categories and subcategories that exceed the regional and lower sodium reduction target set by the PAHO (n=1,977).

Food category	Subcategory	n	Regional target	% above the regional target	Lower target	% above the lower target
Bread		215	600	29	400	69
Soups		86	360	73	306	88
Mayonnaise		29	1050	14	670	41
Biscuits and cookies						
	Cookies and sweet biscuits	594	485	12	265	53
Cakes		132	400	16	205	72
Meats						
	Cooked, uncooked and processed meats and sausages	82	1210	2	690	91
Breakfast cereals		404	630	4	500	22
Butter		40	800	0	500	8
Snacks		234	900	35	530	83

Pasta						
	Shelf-stable pasta and noodles (dry, uncooked)	161	1921	12	1333	23

PAHO: Pan American Health Organization.

4. Discussion

Many processed food categories contained excessive amount of sodium, being the processed meats (ham, bacon and sausages) those that have the highest concentrations. In addition, in the sample studied, we found that the proportion of foods classified as compliant was lower for international targets (UK FSA and PAHO) compared to the Mexican standards established by COFEPRIS. Finally, to our knowledge, this is the first paper that evaluates and monitors the sodium content of processed foods in Mexico. In general, the maximum sodium content in processed foods established by international (UK FSA) and regional (PAHO) agencies are lower than the levels suggested by COFEPRIS in Mexico, which are still high if we want to meet the WHO recommendation of sodium intake of less than 5 grams per day. This evidence might motivate the utilization of regional and international targets to monitor and evaluate the progress made by the food industry. As part of the policy package to stop the epidemic of diet related diseases, like hypertension and cardiovascular diseases, in Mexico; the Mexican food stamp (COFEPRIS criteria) should have the ability to identify products high in sodium content. We found statistically significant differences in the proportions of foods complying with FSA targets and COFEPRIS criteria. This might be partially explained by the close participation of the food industry in the design of nutrient profiling systems.

This participation has traditionally been given through committees made up by COFEPRIS. In fact, a case study recently documented the interference of the food industry in the profiling system of the Mexican front of package labelling[28]. Since the compliance is easy to meet, the current strategy does not promote food reformulation. The Mexican government could reduce the cut-off points of the nutritional stamp to promote processed food reformulation by food manufacturers. In this sense, the definition of new maximum levels of sodium in processed food could contribute to the reduction in the dietary sodium intake among Mexican population. Despite the existence of Mexican voluntary targets, without government surveillance and regulation, experience has proved that it is not a sufficient incentive for the food manufacturers to reformulate products[29].

Ultimately, to substantively reduce dietary sodium intake across the Mexican population, mandatory targets will be needed for processed foods; ideally, looking for a gradual transition to more strict profiles such as the PAHO benchmarks. Setting targets is feasible, a number of countries in the Pan-American region, like Argentina, Brazil and Canada, had implemented timelines for food reformulation [24]. Besides, existing food technology can help to maintain taste when reducing the sodium content [30]. Furthermore, after the reformulation is important to monitor adherence to targets; such monitoring system should be transparent and regularly verified[31]. Public education and social marketing are also needed to motivate the population to choose a healthier diet with less sodium content[32]. Afterwards the demand for low and sodium free products is expected to rise. Other strategy that could have a population approach to reduce sodium intake in the Mexican population is the front of package labelling. In Chile, for example, their warning labelling system is very easily understood by population, which helps consumers make healthier food choices. Besides,

Chile's criteria is stringent because it was based on evidence. The implementation of their front of package labelling system had a plan to implement progressively thresholds to move closer to PAHO criteria [11]. The local government of Mexico City has had some steps forward in reducing the sodium intake among the population. There is a local strategy that aims to reduce sodium intake. The campaign "Less salt, more health", which removed saltshakers from the tables of restaurants. In a recent evaluation 5179 restaurants followed the campaign aiming to reduce sodium intake among the population [12]. One of the limitation of the strategy is that the daily consumption of sodium cannot be track; therefore, it is hard to prove that removing saltshakers from tables is effective. Future assessments of this strategy are highly desirable. Another effort is the national agreement to reduce 10% the sodium content of bread [13]. This voluntary agreement was implemented during 2012; however, an evaluation of this public health measure has not been conducted.

This study used data taken from the package and labelling of processed foods. Does not evaluate individual sodium intake. Open-access food composition data provided by the food industry would simplify efforts to monitor and assess the content of food products and their nutrients of concern. This study was cross-sectional; therefore, it does not evaluate the progress in reformulation. In future, data from different years will be needed to assess the reformulation of the nutrition content. Research is needed to assess the national and local initiatives and also to evaluate the sodium dietary intake and the contribution from processed and ultra-processed foods to the diet.

5. Conclusions

These data provide a critical baseline assessment for monitoring sodium levels in Mexican processed foods. This assessment will allow further monitoring of sodium levels towards food industry reformulation. All sectors, policy makers, food industry, and consumers, need to be encourage to reduce the amount of sodium added to food or processed foods. The majority of food groups were found to be high in sodium. Most of them are above the COFEPRIS criteria which are less stringent than the international or regional targets. Processed foods are widely consumed by the Mexican population; therefore, it is necessary to implement strong regulations to reformulate processed foods available in the Mexican market. This measure could have the potential to decrease the health risk due to a high sodium intake.

Author Contributions: CN performed the statistical analysis, and drafted the manuscript. LTM coordinated the data collection and critically revised the manuscript. EMF interpreted the data, and wrote results. CM provided guidance for the analysis and worked the discussion. EDG interpreted the data and gave input for discussion. SB was responsible for data acquisition and provided the research idea. All authors read and approved the final version of the manuscript.

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