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Food Safety Review (FSR) in the State of Kuwait as a part of Arab Gulf Area

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Abstract

The Food Safety Review (FSR) is a partnership between industry, government, academia, and the consumer. The reason of our review is to increase consistency among local health departments and their interpretations of the state food service rules. The mission of the FSR is to works in partnership with the department of health in developing advisory technical interpretations of the state food service regulations and other matters relating to Kuwait Administrative Code, interpretation of food handling practices and processes, guidance on "equivalency" determinations, providing recommendations for revisions to the Kuwait state board of Health, and finally facilitating communications to all stakeholders regarding FSR activities and actions. This review gives a comprehensive evaluation of the safety and quality of food consumed in the state of Kuwait. The database presented in this review has been gathered from projects, local Kuwait conferences and published papers, by different scientists in Kuwait, regarding food safety, quality, health, spoilage, contaminants, and general awareness of hygiene. As a result of the information presented in this review a detailed action plan for the strengthening of Kuwait food safety system is proposed.

Key words: Food safety, quality control, food analysis, food regulation, Kuwait

Introduction

Location and Population. Kuwait is a small Arabian state located on the top of the Arabian Gulf (Fig 1). The mid-year population of the country in 2009 was 3.399 million of which 31% were Kuwaiti nationals and 69% were non-Kuwaitis. The ratio of males to females among the total population was 1.6: 1 (1:1 among Kuwaitis and 2.2:1 among non-Kuwaitis) due to the large proportion of single men among the immigration at work force present in the country (PACI, 2009). Kuwait is an Arabian country with about 90% of the population living in Arabian areas (FAO 2006a).

Source of wealth. Kuwait enjoys a high per capita income when compared with both industrialized and developing countries. The discovery of oil in large quantities generated sudden wealth and the average family income increased sharply. Generous and varied food supplies became available on the market, and with the high purchasing power, meal patterns became more varied. The traditional diet is rapidly disappearing and being replaced by a much more diverse diet (Al-Awadi F, Amine EK. 1989).

Fig 1. Kuwait Map with all of the governates

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Health and education. Kuwait has a highly developed health service which is offered free of charge. Kuwait has also achieved remarkable progress in the field of education and the illiteracy rate has been reduced to around 26.4%. Heart diseases, cancer, and injury (particularly transport accidents) are the three major causes among both Kuwaitis and non-Kuwaitis. Gender wise, higher mortality rates observe among men from heart diseases and transport accidents. However, higher death rates due to cancer are reported among women (FAO 2006a).

The World Health Organization lists Kuwait as the 8th fattest country in the world with a 74.2% prevalence of overweight individuals between Kuwaitis (WHO 2008). They are heavier than the Americans and report the highest rate of obesity of all Gulf Arab countries. Kuwaitis have the highest prevalence of hypertension and elevated cholesterol levels in all the Gulf region and Kuwaitis rank 5th for the global prevalence of diabetes behind Nauru, UAE, Saudi Arabia and Bahrain. Small-scale national studies report that only 2 - 5% of Kuwaiti population is physically active despite the fact that International Diabetes Federation tells us that up to 80% of type 2 diabetes is preventable by adopting a healthy diet and increasing physical activity (Akanji 2002).

Agriculture. Agriculture is limited by the lack of water and arable land and by harsh climate conditions. Out of 17818 km2, only 1538 km2 are used for pasture, trees and crops. Most of the food commodities for human consumption are imported, with the exception of aquatic resources which are plentiful. However, most of the captured fish and seafood is not consumed but is exported (MOP 2004a.). The main food agriculture commodities produced in Kuwait in 2002 were fresh vegetables, cow milk and poultry meat. All these commodities were destined to local human consumption. Winter, summer and semi-perennial crops include fruits, leafy vegetables, tubers and pulses. Vegetables such as tomatoes, cucumbers, lettuce, bell peppers, etc., and fruit such as strawberries are grown in green houses and in some cases exported to neighbouring countries (FAO 2006a).

Water supply. Kuwait has limited natural fresh water resources, and desalination facilities provide most of the water for human consumption (FAO 2006 a).

Food supply. Kuwait has a vulnerable food supply, and its food industry is diversified; it covers most food found in the developed and underdeveloped countries ranging from bread, water, meats, fish, poultry and eggs, dairy, vegetables, legumes, and confectionary. Food processing plants for all of theses mentioned food are available and are in constant challenged by imported high quality food items. Because of the multicultural population, supermarkets and restaurants of different style common to Arabs, South east Asia, Japan and America are everywhere in Kuwait. Kuwait is in compliance with the World Trade Organization's Trade Related Aspects of Intellectual Property Rights agreement. Brand registration is recommended to protect both the importer and the foreign supplier against parallel imports and copycat labels.

Food consumption patterns. The main staple foods are rice and wheat. Normally three meals are eaten per day (breakfast, lunch and dinner). Lunch is eaten mostly at home, and consists of rice with meat, chicken or fish, with vegetable stew, salad and yogurt or buttermilk. Chicken and lamb are the most common sources of animal protein; beef and pulses are less frequently consumed. Dairy products are frequently consumed. Fruits are available throughout the year and are frequently consumed. Dairy products are frequently consumed. Fruits are available thought the year and are financially accessible to all. Dinner is mostly eaten outside or ordered from restaurants and is often composed of fast foods such as pizza, fried chicken, hamburgers, kabab (traditional dish based on meat-usually sheep meat), sandwiches etc. Traditional sweets are replaced by jams, honey and chocolates. Tea and Arabic coffee are the most common hot drinks and fresh juice and carbonated beverages are the most common cold drinks. A variety of nuts is consumed in Kuwait mostly after supper or while watching television (FAO 2006a).

Food security. Both Kuwaitis and non-Kuwaitis have adequate access of foods. Cooperative stores supplying food are situated in all areas of Kuwait. The population of Kuwait is not affected by food insecurity (FAO 2006a).

Micronutrient deficiencies. Kuwait is one of the richest countries in the world yet micronutrient malnutrition persists alongside over nutrition such as iodine deficiency (WHO, 2004), Vitamin A deficiency, iron deficiency (Jackson and Al-Mousa, 2000) and vitamin D deficiency.

The present review is just a beginning to summarize the food safety status in Kuwait and needs to regular update to help whom car in human health strategy.

The food safety and control system in the State of Kuwait

Kuwait consist of six governments, each has a Kuwait Municipality (KM) food Control/Inspection regional office (Fig 1). In addition, there are five regional KM slaughter houses, and five regional KM food import offices. The food laboratory ministry of health (FLMOH) has only one site and act as the technical arm for all KM activities in the area of food analysis. All of the 16 regional KM offices are supported with food inspectors that act as another technical arm for all KM routine food inspection activities enforcing food inspection laws. Health Colleges provide technical labours and supports for Kuwait food industry. Scientific researches are provided to support KM, ministry of health (MOH), and Public Authority for Applied Education and Training (PAAF) on strategic issues to help in improving their functional role. In Kuwait, major research activities are carried out by a governmental body mainly by Kuwait institute for scientific research (KISR), Kuwait University (KU) and (PAAT) which provide researches and technical support to the food sector. The Kuwaiti food safety and

control system (KFSCS) aims to safeguard Kuwaiti's food supply with high-quality and safe standards. There are four main governmental authorities that are concerned with food safety and control, these are.

1) Food Control/Inspection. the controlling and inspection of food products manufactured by local industries including slaughterhouses control and food markets control. Such task is the responsibility of KM.

2) Food Import. controlling and inspecting imported raw and finished products to determine suitability and acceptability for human consumption takes place at Food laboratory, Ministry of Health with the help of inspectors of KM.

3) Enforcing food standards. which define quality and minimal acceptability for foods produced locally or imported Foods standards are enforced by four authorities are.

i. Standards and Metrology Department (SMD) of the Public Authority for industry (PAI). All the food standards are based on Codex. There are 556 standards; more than 25% of them are mandatory standards.

ii. The KM is responsible for taking samples, inspecting factories, stores and market places for foodstuffs to ensure the satisfaction requirements.

iii. FLMOH runs tests on the samples which are taken by the Municipality in the bacteriology and chemical laboratories, and responsible for insuring that the food produced or imported into the country and sold within the country is safe.

iv. Public Authority for Agriculture and Fishing Resources, (PAAFR) is responsible to run tests on samples at their laboratories of Fresh vegetables, Fruits, fresh meat, fresh poultry, and inspection of all local farms products, for insuring its safety for human consumption.

Food Laws in Kuwait

Food safety and control system regulations are set by PAI, KM, MOH, PAAF, and KISR. These regulations are compulsory, must be observed by any one who deals with food and all food products are subjected to inspection in accordance with these food regulations. The main food laws are. KM 21/92 that is related to food in general, KM 25/92 that is related to mobile shops sells convenient and cooked food, KM 26/92 that is related to shops and factories sell or manufacture food, GCC food standard 21/1984 that specify hygiene rules (prerequisite programs) that must be established by food factories, GCC food standard 150/1993 that specify the date of expiry of packaged food, PAI food standard 42/1973 that deals with food label, GCC food standard 23/1998 that deals with food colors, and MOH food standard 231/1989 that deals with special foods. Foods before harvest, of animal or plant origin, are controlled by the PAAF (BNET 2003). Where, live animals and plants, feedstuffs and horticultural products are inspected at the port of entry, to determine if quarantine is warranted. Boxes for fresh fruits and vegetables are regulated, but no special packaging type or size is required for other food products, unless incorporated in processed food regulations. Imports of irradiated food products are permitted, as long as labels clearly indicate irradiation. Kuwait enforces GCC shelf-life standards for 44 food products and recognizes manufacturer-established shelf-life standards for all others. Products not on the list must have half their stated shelf-life remaining to be eligible for entry into GCC markets. Special food products such as diet, health and infant foods and artificial sweeteners must be pre-registered with the Kuwaiti Nutrition Dep. of the MOH. Labels for these products must include information about ingredients, nutritive value, any health warnings and instructions for proper use and storage. Regulations governing the use of food additives are based on Codex Alimentarius standards, as are pesticide and other contaminant residue levels.

Human Health in Kuwait

Aflatoxin M1 Residues

Levels of aflatoxine M1 in milk, cheese consumed in Kuwait was carried out, with a total 321 milk samples, where result revealed that all fresh milk (177 samples) were contaminated with M1 ranging from 4.9 – 68.7 ng/kg eight of which above the regulatory limit, long- life milk (105 samples) ranging from 0 – 88.8 ng/kg four of which above the regulatory limit, powdered milk (27 samples) AFM1 ranged from 2.04 to 4.14 ng/kg. Of the human milk samples, only five were contaminated, with AFM1 levels ranging from 8.83 to 15.2 ng/kg with a mean 9.7 ng/kg (Dashti et. al 2009). The cheese samples recorded 80% contamination with AFM1 with a range 23.8–452 and mean of 87.6 ng/kg, with one sample being above the regulatory limit (250 ng/kg) while the feed samples, showed 79.8% contamination with total aflatoxin. Also, the concentration levels of Aflatoxin M1 in milk samples were tested (Alaa et. al, 2005a), during the period of May 2004 to June 2005, from 23 countries (Local and Imported), where out of 105 samples tested they found 86 negative samples (81.9%), and 19 suspected positive samples (18.1%) more than the permitted levels of Kuwaiti specification (more than 0.5 ug/kg). A study at 2004 conducted on 124 milk samples showed that 61.3% of all of the samples were positive with AFM1 levels ranging from 5.3 to 82.1 ng/ kg, and 21% of the samples were above the action level for AFM1 (Dashti et al 2004). Other study shows 28 % of samples of fresh full cream and skimmed milk, powdered milk, yoghurt, and infant formula were contaminated with aflatoxin M1 (AFM1) but only 6% being above the maximum permissible limit of 0.2 μg/l, and powdered milk and infant formula samples were free from contamination of aflatoxins. . Three fresh cow milk samples collected from a private local producer showed the highest level of 0.21 μg / l AFM1 (Srivastava et. al 2001).

Antibiotic and Drug Residues.

Analysing the tetracycline residues in foods marketed in Kuwait were also carried out revealed 100% of tested eggs, meat, fish, ice cream and cheese were found to be within the limit, while 5% of poultry and 18% of milk samples were above the permitted limit (Al-Mazeedi et. al 2009). Locally produced and imported milk and dairy product samples were screened for the presence of four antimicrobial residues (beta-lactams, tetracyclines sulfonamides and chloramphenicol) (Alomirah et al 2007). Results indicated that 29.1% of the analyzed local fresh milk samples were above the maximum residue level (MRL) for tested residues with tetracycline as predominant residue. The prevalence of antimicrobial residues in imported pasteurized milk samples (5.4%) was higher than that of local pasteurized milk samples (3.4%). No residues were detected in powdered and condensed milk samples imported from the European Union (EU) countries with the exception of tetracyclines. Results also showed that 9.4% of the analyzed imported cheese samples were above the MRL for tested residues, while tested ice cream samples were negative for antimicrobial residues. Furthermore, a total of 238 locally produced and imported eggs, tissue (meat, poultry and aquaculture fish) and feed and feedstuffs samples were collected at different seasonal periods from different farms and retail outlets in Kuwait and screened for the presence of β-lactams, tetracyclines, sulfonamides, streptomycin, macrolides and chloramphenicol (799 tests) using Charm II system. Results indicated that all of the 222 tests performed on table egg samples were negative for the analyzed antimicrobial residues indicating adhering to guidelines for antimicrobial use and withdrawal. Similarly, all of the 268 testes performed on tissue samples were negative for the analyzed antimicrobial residues except for chloramphenicol. These chloramphenicol positive samples (10.8%) were for chicken parts imported from China. For feed and feedstuff samples, all of the 66 tests performed were negative for β-lactams residues. Out of the 79 feed and feedstuff samples analyzed for tetracyclines residues, 4 broilers diet and concentrate samples (5%) were above the tetracyclines MRL (100 ug/kg). On the other hand, results have revealed a widespread of sulfonamide residues and to a less extent chloramphenicol in tested feed and feedstuff samples (Alomirah et al 2007). Tetracyclines residues studied by Kuwait Public Health labs revealed that 5.6% of poultry samples were above the allowed limit. The contaminated poultry came from local origin and ranged from 79- 200 µg/kg (Alaa B et. al, 2006).

Artificial Colour levels in Food products.

A total of 136 of saffron marketed samples, from 3 countries origin, collected during a period of January 2009 to January 2010. Screening test was carried out by official paper chromatography and confirmed, quantify by liquid chromatography revealed that 60.3% of tested saffron non-fit for human consumption [mainly contain Ponceau 4R (E124) and Erythrosine (E127)], 5.9% was not confirmed [contain Sun set (E110), tartazine (E102), carmasin (E122) and Allura red (E129)], and just 33.8% of the samples were safe (Alaa et al 2010). Children in private schools showed a lower intake of synthetic colour additives compared to children from public schools. Also, Kuwaiti children's intake of synthetic colour additives was significantly greater than that of non-Kuwaitis children (Sawaya et al 2008). A national field survey, conducted between years 2001-2002, assessing the intake of artificial food colours by children (4-14 year-old) in the state of Kuwait, found that out of nine permitted colours, tartrazine, sunset yellow, carmosine and allura red exceeded their ADIs. Higher consumption of drinks and juices contributed 83, 68, 87 and 42% to the average daily intakes of tartrazine, sunset yellow, carmosine, and allura red, respectively, whereas consumption of chips and puffed snacks contributed 20 and 29% to the average daily intakes of sunset yellow and allura red, respectively. Moreover, some non-permitted colours, e.g., E127 (erythrosine) and orange G were identified in some samples (Husain et al 2006a). Several permitted colours (tartrazine, sunset yellow, carmosine, allura red, brilliant blue, and brown HT) that were not listed on the labels were also detected (Husain et al 2006b).

Pesticide Residues

Data from the monitoring program and other sources revealed local instances of high levels of chemical contaminants in food in developed countries (UNEP/GEMS, 1992 and UNEP/FAO/WHO, 1988). Though this is a cause of concern, the data suggested that the problem was more widespread and acute in developing countries, where fewer regulations govern industrial and agricultural practices. Contamination of the organo-phosphorus (OP), insecticide ethion residues in commercial samples of red-hot chilli spice in Kuwait, determined by gas chromatography analysis with tandem mass spectrometry detection mode. The results of this study clearly demonstrated that the percentage of ethion residue levels decreased remarkably from 81 to 19% of 156 and 384 red chilli samples analysed during 2004 and 2005, respectively (Ali et al. 2009). Further results also showed that only 15% of 225 samples analysed in 2006 were found to be contaminated with the residues of ethion pesticide, whereas the decrease in residual ethion contamination percentage level was slightly varied to 16% of 450 samples surveyed in 2007. Mean concentrations of ethion residues were less than 2 µg/kg, in all tested hot chilli pepper varieties. Also, levels of 6 detected phosphorylated pesticide residues in the total diet of Kuwait were determined (Saeed et al. 2005) where a total of 136 core samples (and 90 related items) were analyzed. The results indicated that 25 of the items (about 18%) in the Kuwaiti diet contained detectable residues. In total 6 pesticides were detected. Monocrotophos (0.2 mg/kg), diazinon (0.05 mg/kg), and quinalphos (0.022 mg/kg) were present in only one sample. Chlorpyrifos-

methyl and fenitrothion were the most commonly detected pesticides. Chlorpyrifos-methyl was present in 19 items and ranged from (0.01 to 0.33 mg/kg) while fenitrothion was detected in 8 samples, ranging from 0.016 to 0.84 mg/kg. The levels of most of the pesticides in the positive samples were relatively low except for fenitrothion in brown bread (0.84 mg/kg) that exceeded the maximum residue limit (MRL) set for white bread (0.2 mg/kg) by FAO/WHO [7]. The levels of the rest of the phosphorylated residues were lower than their MRLs, except for chlorpyrifos-methyl, which was detected at almost 42% of the MRL (0.5 mg/kg), but exceeded it (0.72 mg/kg) in brown flour. The organo-chlorine(OC) pesticide, carbamate, benzimidazole and phenyl urea contents were studied. Twenty-five of the foods analyzed contained OPs. These included 7 of 12 cereal products (chloropyriphos=0.03–0.21 ppm and fenetrothion=0.016–0.84 ppm), 6 of 16 vegetables (diazinon=0.05–0.2 ppm, and chloropyrifos, and fenthione sulfone), 1 of 16 fruits (monocrotophos) and 11 of 47 composite dishes (chloropyrifos methyl=0.011–0.089 ppm and fenetrothion 0.011–0.044 ppm). The higher levels of fenetrothion in one cereal product exceeded the MRLs, and warrant corrective and preventive measures (Sawaya et al 2000). Also, the residues of chlorinated pesticides were assessed. 140 core samples along with 90 additional samples (collected during 1995–1996) were analyzed following US FDA multiresidue procedures. The results showed that 17.6% of the core samples contained detectable residues. Chlorpyrifos-methyl was present (ranging from 0.05 to 0.72 mg/kg) in most of the positive samples. Wheat flour was the single important source of this residue in the diet. Residues of chlorpyrifos, vinclozolin, procymidon and captan were also detected in some fresh fruits and vegetable. In general, residue levels were quite low and were significantly below the maximum residue limits (MRLs) established for these pesticides in food (Sawaya et al 2000).

The State of Kuwait in cooperation with the U.S. Food and Drug Administration (FDA) conducted a Total Diet Study (TDS) to estimate intakes of pesticide residues by the population. The levels of organochlorine (OC) pesticides, carbamates, benzimidazoles, and phenylureas in the TDS core list are reported. The TDS core list was established through a national food consumption survey. All food items (140 for the Kuwaiti adult) were prepared as eaten and analyzed for the pesticides mentioned above. Where, the average daily intakes were below acceptable limits, but higher than those reported from developed countries. Only vegetable and fruit samples contained pesticide residues (mg/kg), including the carbamates 1-naphthol (1.4) and 3H-carbofuran (0.94) in carrots; the OC pesticide vinclozolin (0.47), 3H-carbofuran (0.66), and fenuron (0.6) in kiwi fruit; the OC pesticide procymidone (0.32) and carbendazim (0.5) in grapes; 3H-carbofuran (5.0) in apricots; the OC pesticides captan (0.013) and thiabendazole (0.63) in pears; captan (0.035) in plums; and carbendazim (0.4) in mandarin oranges (Sawaya et al 1999a). The levels of 3H-carbofuran found in both apricots and kiwi fruit exceeded the maximum residue limits (MRLs) of the Food and Agriculture Organization/World Health Organization (FAO/WHO 1983) of the United Nations. The daily intakes of pesticides by the different population groups are discussed in light of the FAO/WHO acceptable daily intakes (Sawaya et al 1999b).

Polycyclic aromatic hydrocarbons in food products originating from locally reared animals in Kuwait.

Analysis for the presence of 12 polycyclic aromatic hydrocarbons (PAHs) in 327 foodstuff samples originating from locally reared animals was carried out. The data revealed that non-carcinogenic PAHs were detected in considerable amounts in several food commodities. The carcinogenic PAH concentrations were relatively low in most of the samples investigated. Among the carcinogenic PAHs detected, chrysene had the highest concentration (Husain et al 1997). The dietary exposure to polycyclic aromatic hydrocarbons such as naphthalene, phenanthrene, fluoranthrene, pyrene, benz[a]anthracene and chrysene from commercially important seafood (fish and shrimp) of the Arabian was found to vary between 30 and 247 ng/g dry wt. Yellowfin seabream imported from Iran exhibiting the highest concentration followed by Nile tilapia imported from Egypt (218 ng/g dry wt.) and then by locally caught silver pomfret (142 ng/g dry wt.) and Jinga shrimp (139 ng/g dry wt.) (Alomirah et al 2009). The mean exposure for the average adult Kuwaiti consumer to PAHs and benzo(a)pyrene equivalents (BaPEs) was estimated to be 1.3 ng/day and 0.0013 g/day, respectively(Alomirah et al 2009).

Poultry industry in Kuwait

The poultry industry in Kuwait is moving towards production of specialty food such as eggs enriched with omega-3-fatty acids which, it seems, will take part of the market share in the future. A total of 15 of marketed egg samples, 10 classic (11.2 % imported) and 5 fortified (88.23 % imported), from seven countries, collected during a period of January 2006 to November 2006. Screening fatty acid profile test was carried out by gas chromatography where the ratio of alpha-linolenic acid to linoleic acid was calculated. In fortified egg these ratio closed to 1 and fatty acid profiles reveals omega 6/omega3 ratio in classic egg ranged between 33 – 75 while in fortified eggs ranged between 1- 10 of tested samples. The local fortified Kuwaiti egg reached the ratio to 3 which nearly confirmed with international results, While the UEA product reached the ratio to 10 , The French egg came from natural and free range hen feeded on natural products but not fortified reveals ratio = 33.3 as well control flex seed oil sample revealed ratio= 0.3. The total cholesterol content remains similar (Alaa et al 2007).

Average per capita consumption of poultry meat before the invasion by Iraq was 22 Kg and after liberation per capita

consumption increased. Red meat consumption was reduced in the years 1996 to 2002. Nasser and colleagues call for more development and improvement in poultry industry of Kuwait since local producers supplied only 47% of the poultry meat and 55% of table eggs (Nasser 2006).

Poultry feed. A survey of a poultry feed production in Kuwait revealed average aflatoxin concentration in maize at 0.27 ppb (range 0 to 1.69 ppb), soybean meal at 0.20 µg/kg (range 0 to 1.27 µg/kg), wheat bran at 0.15 µg/kg (range 0 to 1.07 µg/kg), prepared poultry feed for broiler starter at 0.48 µg/kg (range 0 to 3.26 µg/kg), broiler finisher at 0.39 µg/kg (range 0 to 1.05 µg/kg), and layer mash at 0.21 µg/kg (range 0 to 1.30 µg/kg) (Beg et. al 2006). The average levels of ochratoxin A ranged from 4.6 to 9.6 µg/kg, fumonisin from 1.4 to 3.2 mg/kg, deoxynivalenol DON from 0.17 to 0.29 mg/kg, and zearalenone from 46.4 to 67.6 µg/kg in various commodities, and prepared feed samples. The authors concluded that mycotoxins concentrations in general were found to be lower than the permissible levels (Al-Hamili et. al 2007).The study showed average aflatoxin concentrations varying from 0.15 to 0.48 ng/kg in maize, soybean, wheat bran, and prepared poultry feed for broiler stout, broiler finisher and layer mesh. All of the mycotoxins were below the maximum permissible levels (Beg et. al 2006).

Hormones

Assessment of the status of six steroids and three *β*-agonists compounds in Kuwait's meat industry was carried out with recoveries of the anabolic compounds ranged from 77% to 99%. The method was employed to conduct a preliminary survey of Kuwait's meat market. None of the 262 samples analyzed contained detectable levels of anabolic agents. (Saeed et al 1999).

Honey analysis.

Comparative study on the determination of 5-Hydroxymethylfurfural (HMF) in different Honey samples at Kuwait market by two simultaneous methods was carried out (Wafaa et al 2010), where out of 553 honeys sample 5.78 % were rejected due to HMF values which ranged between 85 – 765 mg/kg, and 20.3 % ranged between 40 – 80 mg/kg .

Heavy metals

Food samples collected in the winter of 1997 and again in the summer of 1998 in Kuwait were analyzed for their heavy metals, polycyclic aromatic hydrocarbons (PAHs) and selected radionuclides contents. High Cd and Pb exposures are encountered among young children. Exposures to PAHs of the different age groups of the Kuwaiti population were not unusually high. Dietary exposures to 90Sr were all below WHO, however data for 137Cs were slightly above and 226Ra exposures were all well above WHO standards for all age groups, but still below the United States Food and Drug Administration's (USFDA's) intervention levels (Husain et al 2003). Also as a part of the public health laboratory program on monitoring of the concentration levels of titanium oxide (E171) in Tahini samples, using ICPEAS and spectrophotometric methods. The results reveal that 48 % of marketed Kuwaiti Tahini is contaminated with TiO2 where, 24 % of total samples contain more than 200 µg/ml, 16 % is ranged from 50 – 200 mg/kg, and 8 % contains from 5 – 20 mg/kg (Alaa et al. 2005b).

Trace-Element Status in Milk and Plasma of Kuwaiti and Non-Kuwaiti Lactating Mothers was carried out (Farida et al. 2000). Milk samples (from 34 donors) were collected to analyze where only zinc in plasma of Kuwaiti mothers were significantly higher than those of non-Kuwaitis. Concentration of zinc, copper, manganese, and total protein in milk of both groups decreased as lactation continued but that of milk iron and plasma trace elements remained unchanged. High protein content in association with high concentration of trace elements in milk of Kuwaiti versus non-Kuwaiti mothers may indicate that protein content in milk is an important determining factor for the concentration and bioavailability of these elements. The differences in the protein levels and trace-element contents in the milk of the Kuwaiti and non-Kuwaiti mothers suggest that the concentration and thus the bioavailability of zinc, copper, and iron in milk is determined by the protein content but that the concentration of manganese is not.

Nutritive value of Kuwaiti dishes

Assessing the nutritional values of Kuwaiti dishes is essential for its effect on health and usefulness to nutritious in order to make a general shift away from fat consumption, and to the consumption of complex carbohydrates in the form of more polysaccharides and less simple sugars. The nutritive value of 32 Kuwaiti dishes were analyzed for approximate analysis (moisture, protein, fat, ash, fibre, and carbohydrates), energy, phytic acid, minerals, vitamins, amino acids, protein quality, fatty acids and cholesterol (Dashti et al 2003).The popular dishes consumed by Kuwaitis were mainly composite dishes such as Machbous (rice and chicken), Marag (stew), and ready-made foods (Hamburger, pizza. Etc.,) or foods consisting of one main ingredient (fried potatoes, fish, etc.). As general observations, dishes containing rice were low in moisture content but high in protein, fat and energy, than those cooked with vegetables. Meanwhile, Marag and salads since they contain vegetables had more, dietary fibbers, vitamins and more minerals while dairy dishes contained 0% fibre. The phytate content was more in dishes consisting of legumes or wheat products. The protein quality of cooked dishes, as indicated by C-PER vales relative to casein, was higher in animal-based dishes, than those which were plant-based.

Other study of 33 dishes commonly consumed in the state of Kuwait was analyzed (Hanan et al 2008). On a fresh weight basis, the moisture content of the dishes ranged from

0.29% to 94.37%, protein content from 0.65% to 24.80%, and fat content from 0.03% to 59.22%. The crude fibre ranged from a low value of 0.04% to a maximum of 2.31%; with the exception of four dishes—Sw-20 (Samsamia), Sw-26 (Harda), V-31 (Hameesat Mushroom), V-32 (Hameesat Fagae)—all dishes had a low fibre level, <1 g/100 g. The ash content ranged from 0.09% to 3.66%. Carbohydrate showed a variation between 3.98% and 81.37%; the highest carbohydrate values were in sweets and rice-based dishes, while the lowest values were in soup and cheese dishes. The energy content of the dishes varied between 19 and 675 kcal/100 g (80–2,823 kJ/100 g). The dishes contributed 5–90%, 1–46% and 1–83% of the total food energy from carbohydrate, protein and fat, respectively.

Also, twenty-two Kuwaiti composite meat, fish, chicken, cereal, and sweet dishes were analyzed for 14 mineral elements and 11 vitamins (Sawaya et al 1998a). The results indicated the following concentrations (mg/100 g). sodium, 2–910; potassium, 21–620; calcium, 13–520; phosphorus, 17–360; magnesium, 11–103; iron, 0.2–2.9; copper, 0.05–0.40; manganese, 0.10–2.70; boron, <0.05–0.74; chromium, <0.05–0.09; aluminium, <0.05–1.80; iodine, <0.01–0.28; and selenium (μg/100 g), 0.76–63.00. The concentrations of the vitamins were. vitamin A traces-207 retinol equivalent/100 g; vitamin D traces - 156 I.U.; vitamin E traces - 2.92 mg α-tocopherol/100 g; vitamin C traces - 6.3 mg/100 g; thiamine, 0.008–0.384 mg/100 g; riboflavin, 0.023–0.855 mg/100 g; pyridoxine, 0.024–0.206 mg/100 g; niacin, 0.11–5.34 mg/100 g; pantothenic acid, 0.113–1.36; biotin, 0.001–0.009 mg/100 g; folacin T, 62 μg/100 g; and vitamin B12 T, 1.32 μg/100 g. These results are discussed in relation to the Recommended Dietary Allowances for the U.S. population set by the Food and Nutrition Board, National Research Council, National Academy of Sciences.

Cholesterol content of the dishes ranged from traces in dishes containing legumes to 95.91 mg/100 g in dishes containing shrimp such as Hammest Rubyan. Other dishes containing high content of cholesterol include lamb meat dishes such as Kofta where cholesterol content is 61.16 mg/100 g, and dairy and sweets dishes rich in eggs such as Qours Okaili (71.21 mg/100 g) (Donmez et al 2005). During puer perium, the high consumption of certain Kuwaiti dishes (Aseeda and Heso) was found to be low in essential nutrients such as iron and zinc, and these should be modified. The rice dishes do not provide a significant amount of many nutrients; however, they contain high levels of carbohydrates and low levels of fat. Although the diets in the GCC countries can be considered as Middle Eastern diets, the intake of animal proteins is much higher than that in the rest of the Middle East countries and compares well with Western countries intakes, and, consequently, might play a positive role in the improvement of the bioavailability of minerals in the diet.

Amino acid composition of Kuwaiti dishes when compared with the WHO amino acid requirement pattern for the young child was studied (Eid and AlAwadi 1998), where 19 out of 22 dishes showed deficiency in certain essential amino acids. In the meat group 5 dishes were almost deficient in the sulphur amino acids (methionine and cystine). The chicken-based dishes were also deficient in tryptophan, whereas in the sea food dishes, only 1 dish was deficient in tryptophan. The limiting amino acid in the sweet dishes were equally limiting in tryptophan followed by lysine and threonine. Likewise the limiting amino acid in the cereal-based dishes was tryptophan in some dishes followed by lysine and threonine in other dishes. The chemical score which is an index of protein quality, ranged from 15 to 85. The low protein quality of some sweet dishes (cinnamon date sweet) is attributed to the low tryptophan content in dates and white flour constituting the main major ingredients of the recipe. Other sweet dishes although they contain flour as a major ingredients in the recipe the substantial amount of eggs in the recipe substitutes for the deficiency. The cereal-based dishes are deficient both in tryptophan and lysine, due mainly to the relatively low levels of these amino acids in cereals. In the rest of the dishes, although tryptophan is limited, the chemical scores are relatively higher in the meat, chicken and sea food dishes than in the sweets and cereal-based dishes (AlAmiri 2001).

Minerals and vitamins

Studies found in Kuwaiti composite meat, fish, chicken, cereal, and sweet dishes show the following concentrations (mg/100 g). sodium, 2-910; potassium, 21-620; calcium, 13-520; phosphorus, 17-360; magnesium, 11-103; iron, 0.2-2.9; copper, 0.05-0.40; manganese, 0.10-2.70; boron, <0.05-0.74; chromium, <0.05-0.09; aluminum, <0.05-1.80; iodine, <0.01-0.28; and selenium (g/100 g), 0.76-63.00. The concentrations of the vitamins were. vitamin A traces, 207 retinol equivalent/100 g; vitamin D traces, 156 I.U.; vitamin E traces, 2.92 mg -tocopherol/100 g; vitamin C traces, 6.3 mg/100 g; thiamin, 0.008-0.384 mg/100 g; riboflavin, 0.023-0.855 mg/100 g; pyridoxine, 0.024-0.206 mg/100 g; niacin, 0.11-5.34 mg/100 g; pantothenic acid, 0.113-1.36; biotin, 0.001-0.009 mg/100 g; folacin T, 62 g/100 g; and vitamin B12 T, 1.32 g/100 g (Sawaya et al 1998b).

Bread

The Proximate and elemental composition of wheat flour and major of bread consumed in Kuwait were studied where significant loss of fat content (P^ 0.01), loss of most type of element (P^0.05) where found in bread compared to wheat flour (Kashlan et al 1991). Also the addition of up to 16% of sunflower seed to wholegrain and refined (white) wheat breads to increase their content of tocopherols, essential fatty acids, crude fibre, copper and zinc. It was estimated that wholegrain supplemented breads would contribute to the corresponding DRIs up to 40.8% for copper, 25.3% for zinc, 37.9% for linoleic (omega-6) acid, and 11.0% for alpha-linoleic (omega-3) acid. The author's stress that

consumption of breads supplemented with sunflower seeds could be beneficial for improving the nutritional status of the general population with high bread consumption (Skrbic et al 2008 and Kashlan et al 1992).

Moisture, protein, fat, fatty acids, ash, fibre and carbohydrates

Data on the proximate composition of the dishes most consumed by the Kuwaiti people(Dashti et al 2003) showed that the moisture content of the vegetable dishes was the highest followed by seafood dishes, chicken and meat; whereas the average moisture content of the sweet dishes was the lowest followed by the cereal-based dishes. The protein content was lowest with salad dishes and highest with sea food dishes followed by chicken, meat, cereal- based, sweets, and the vegetables. The fat content varied between low for bread to Qouzi (lamb meat known to be rich in fat). Among the red meats, lamb meat is the most popular in the Arabian Gulf states and may be considered the main source of red meat consumed by the native population compared with beef in the US and Europe. The fat content of the sweet dishes especially dishes which contain relatively high levels of eggs and butter in the recipes, can also be considered relatively high, whereas the average fat content of the cereal-based dishes was relatively low.

The average content of ash ranged being the highest in the sea food dishes and lowest in the vegetable dish. The crude fibre content was very low, being the highest in dishes containing whole wheat flour, known to be rich in fibre. (Dashti et al 2003). The average content of Kuwaiti composite dishes were found to be 3.7 g/100g for insoluble dietary fiber (IDF), measured in fresh weight, and 1.00 g/100 g soluble (SDF) The IDF was the major dietary fiber fraction in all the dishes. The mean content of total dietary fiber (TDF) was highest in the sweet dishes (4.2g), particularly those containing dates, followed by the cereal-based dishes (3.9 g) containing whole grain wheat flour. The meat- (3.46 g) and chicken-based (2.7g) dishes contained moderate levels of TDF, with the vegetables (3.87 g) in the recipes contributing most of the TDF in these dishes. All these dishes are, therefore, good sources of dietary fiber. The crude fibre content, vitamin A, C and E of most dishes were relatively low (Sawaya et al 1997)..

Kuwaiti dishes had lower values of monounsaturated fatty acids (MUFA) compared to saturated fatty acid (SFA) and polyunsaturated fatty acids (PUFA) where cis-oleic were the major mono-unsaturated fatty acid. Some dishes contained relatively low levels of trans 18.1 fatty acids. Most of the dishes contained low polyunsaturated/saturated (P/S) ratios with only three dishes were close to the recommended ratio of 1.1.1 with the rest being substantially higher, particularly with respect to the saturated fatty acids and hence partial substitution of hydrogenate fat with vegetable oils is highly recommended. The cheese dishes and sandwiches had high dietary energy from fat and may not be suitable for people who should restrict their fat energy intake (Sawaya et al 1998c and Dashti et al 2003).

The total dietary fat exceeds the 30% of the total energy intake. Moreover, the total saturated fatty acids (SFA) were high (mainly palmitic acid and stearic acid); this is of great importance since it is associated with heart disease (Sawaya et al 1998b). The carbohydrate showed that dishes high in cereals and sugars contained higher carbohydrate levels compared with dishes high in meat and vegetables that had high moisture content. The energy content of the dishes varied being the lowest in green salad and the highest in sweet dishes. And an intake of 100 g of the meat and chicken dishes would provide about 5% of the average energy allowance per day recommended for males and 7% for female of the same age. In the dishes studied, the results, in general, indicate that the energy contributed by the average fat content of the different groups was less than 30% recommended by the Food and Nutrition Board, except for the sea food dishes, and some of the meat, and sweet dishes.

Phytate

Phytate acid widely occurs in plant seeds and/or grains roots and tubers, fruits and vegetables, pollen of various species. Phytate contents in foods are important because of the role they play in mineral bioavailability in relation to human nutrition. The highest phytate content was found in dishes containing whole wheat flour, followed by sweet dishes containing wheat flour and dates (Dashti et al 2001). The high phytate level in the shrimp dish may be due to the soil/dirt contents in the back veins of the shrimps that could not have been cleaned well. The reduced bioavailability of minerals due to phytate or phytate protein complexes depends on several factors, such as. nutritional status, concentration of phtates in foodstuff, digestion or hydrolysis of phytate by phytase, ability of endogenous carriers in the intestinal mucosa that absorb essential minerals bound to phytate, processing of products and methods used, and digestibility of the foodstuff. In general, vegetarians consume a higher amount of phytates than non vegetarians (750 mg/day).

Food safety awareness

The extent of knowledge of university students concerning food safety in Kuwait was assessed with test of knowledge, in which only 29% of students achieved a score of 5 or more out of 10. The mean score across all the questions on the behaviour questionnaire was 4.14 of a maximum possible 5. Female students scored significantly better in both knowledge and reported behaviour. Education status of the mother, but not of the father, was a significant factor in both knowledge and reported behaviour. The authors of the report stress that knowledge of food safety in Kuwaiti university students is largely acquired by precept within the home. Future studies should focus on improve actual behaviours (Al-Khamees 2007).

Microbiology

Dairy

Assessing the microbiological quality of raw and pasteurized milk being produced in the state of Kuwait, and the sanitary condition of raw milk in different dairy farms in Kuwait a high incidence of coliform and *E. coli* in raw milk was recorded which indicated poor hygienic standard being observed during milk production and handling (Al-Zenki et al 2007a). Rapid multiplication of these bacteria is likely to affect the keeping quality of the raw milk and of products derived from it. The aerobic plate count (APC), psychrotrophs, pseudomonas and *B. cereus* counts of raw milk ranged from (1X101 to 9X105), (<3 to 9X105), (3 to <105) and (3 to <105) cfu/ml respectively. The APC per ml was generally high in 14 out of 87 (16.1%) raw milk samples ranging from 1 X 105 to 9 X 105 cfu/ml. The counts of coliforms and *E. coli* for raw milk ranged from <3 to >103 organism/ml. The mean counts of APC of pasteurized milk samples of factories I, II and III were (3 X 104), (9 X 10) and (5 X 103) cfu/ml, respectively. In pasteurized milk samples, the number of coliforms ranged from <3 to <10 organisms/ml and the *E. coli* was not counted (less one organisms/ml). From the microbiological point of view, the raw milk being produced on 5 out of 9 dairy farms in the State of Kuwait was found to be of poor quality. Therefore, improving the hygienic conditions on the dairy farms can greatly ameliorate the sanitary status of raw milk and pasteurized milk. *B. cereus* was counted in 23 out of 201 pasteurized milk samples from the three dairy companies and may represent a health hazard (Al-Zenki et al 2007a). The presence of large numbers of coliform bacteria in raw milk with many as 80% of raw milk samples were contaminated with *E. coli*, provides an index of hygienic standard used in the production of milk, as unclean udders and teats can contribute towards coliforms. Results have shown that the mean pH and acidity of raw milk were 6.83 and 0.180%, while the mean pH and acidity values for local and imported pasteurized milk were 6.9 and 0.170%, and 6.8 and 0.150%, respectively(Al-Zenki et al 2007a). Furthermore, all raw and pasteurized milk samples were negative for the clot on boiling test. However, raw milk samples collected from the local dairy farms were unacceptable because of the high somatic cell count and high *Staphylococcus aureus* counts (Project Fnoo2) (Al-Zenki et al 2007a).

Tomatoes.

All samples of tomatoes collected at the farms and the outlets in Kuwait had aerial plate count APC counts less than 107 CFU/g (Al-Zenki et al 2008). Local samples collected from the farms exceeded the microbiological recommendations set for yeast and moulds (10%), faecal Streptococcus (0.7%) and L. monocytogenes (0.7%). Similarly, local tomato samples collected at the outlets exceeded the microbiological recommendations set for yeast and moulds (7.6%) and L. monocytogenes (1.3%). For imported tomatoes, samples exceeded the microbiological recommendations for yeast and moulds (10%), faecal Streptococcus (2.5%) and L. monocytogenes (1.3%). The pathogen, Salmonella spp. was not detected in any of the samples analysed. Improper sanitation, insufficient temperature control and excessive holding-time constitute unsuitable environmental conditions, creating undue physiological losses or losses due to decay by micro organisms. Extreme physical treatment (mechanical injury), on the other hand, causes direct losses or accelerates physiological losses. The occurrence of faecal Streptococcus indicated a possible contamination of the produce with pathogens. Tomato samples collected from the farms and those imported exceeded the recommended limits by between 0.7 and 2.5%, respectively. Poor agricultural and handling practices at the farm level are critical factors responsible for an increase in faecal Streptococcus counts at the retail and wholesale levels in Kuwait. The occurrence of L . Monocytogenes was rather low with percentage frequencies exceeding the microbiological guidelines of 0.7, 1.3 and 1.3% for local samples collected from the farm, retail outlets and imported samples, respectively. The presence of listeriosis on tomatoes is due to the fact that this pathogen has shown to survive for several months in soil and consequently contaminate tomatoes grown in fields or greenhouses (Al-Zenki et al 2008).

Poultry.

The prevalence of Cephalosporin Resistant blaSHV, PER-2 Salmonella Isolated from Poultry in Kuwait where Standard microbiological methods were used to detect Salmonella in 161 poultry samples in Kuwait (Eissa 2010). The antibiotic susceptibility test (AST) results of isolated Salmonella showed that 100% of isolates were resistant to few classes of antibiotics tested. The dominant types of resistance were to 1st, 2nd generation cephalosporins and aminoglycosides. Resistant Salmonella isolates were examined for antibiotic resistance genes. All tested strains were blaSHV positive, 92% were blaPER-2 positive and 42% were blaTEM positive. The most frequent strains identified were Salmonella enterica strain E6 (36%) and nSalmonella enterica strain E5 (26%). Furthermore, variable MIC values were determined for antibiotics tested (penicillins, < 4 - >128; cephalosporins, < 0.25 - >64; aminoglycosides, < 1 - >16, quinolones < 0.25 – 8; sulfonamide < 20; nitrofurantion < 16 – > 512). Similar AST determined of isolates probably reflected the horizontal transfer of antibiotic resistance determinants. Also, the prevalence of cephalosporin resistance genes implied their applicability for further epidemiological studies (Eissa 2010).

Other study showed, the overall percentage prevalence of Salmonella was 5.4% with prevalence rates of 10%, 1.5%, 0.7%, 0.2%, 13.5%, and 12.6% for hatching eggs, litter, feed, drinkers, bird rinse and ceca, respectively. No Salmonella were detected in any of the paper liner, water,

or air samples. Out of 360 samples collected from the processing plant, the overall percentage prevalence of Salmonella was 4.7% with prevalence rates of 6.1% and 3.3% for carcass rinse and ceca samples, respectively. Salmonella Enteritidis was the most prevalent serotype. All of the isolates were resistant to at least one antibiotic. Resistance to ampicillin, nalidixic acid, and tetracycline were the most common (Al-Zenki 2007b).

Storage temperatures and its fluctuations

Market storage temperature of chilled poultry meat in Kuwait were high, averaging 8-10 deg C in more than 50% of the outlets surveyed and the temperature fluctuation in display refrigerators was 1-6 deg C (Abu-Ruwaida et al 1996). Chilled poultry meat stored under simulated market storage temperatures showed that the spoilage rate was directly proportional to the storage temperature and storage period. The shelf life after processing was about 7, 5 and 4 days at 4, 7 and 9 C, respectively. Incipient spoilage was first observed when the log count of spoilage reached greater than 7.2 CFU/ml rinse. Data also showed high initial counts of Escherichia coli and coliforms, indicating poor sanitation during slaughtering. As for food-poisoning micro organisms, 60-80% of the samples tested positive for Salmonella, whereas Campylobacter was detected in all samples. The initial log count of Staphylococcus aureus was 3.4 CFU/ml. This count did not increase substantially during storage at 4-7 deg C, but increased rapidly to >4.4 CFU/ml after 3 days of storage at 9 deg C.

Assessment of the food control system in the State of Kuwait

In four of the GCC countries, namely Kuwait, Qatar, Oman and the UAE, food control is spread across a number of different government ministries and agencies (Al-Kandari and Jukes 2009). In Kuwait, Oman and Qatar, issues directly related to public health, such as food hygiene and sanitation and food borne disease surveillance are dealt with by the health authorities at central and local municipal levels. Matters related to food production, processing and distribution including the control of the quality and safety of foods of animal origin fall under the municipal authority. The Kuwait Food Control System is currently undergoing a comprehensive evaluation and restructuring in an effort to better ensure the safety and quality of foods consumed by the general public. This study intends to assess, characterize and describe the existing food control system in the State of Kuwait and to develop a concept for restructuring it in an effort to create an efficient and effective national food control system. The study included mapping out the current national control system through identifying all governmental bodies responsible for controlling, standardizing and ensuring the safety of the food supply, to characterize their responsibilities and activities, determine the flow of information/communication and to identify problems/constraints occurring within and among these governmental agencies, which are adversely affecting the overall performance. Results indicated that the current Kuwaiti food control system is a multi-layered activity, dependent on multiple players. Government structures and responsibilities of all involved agencies are well defined and documented. However, the Kuwaiti food control system falls short on various aspects and needs to be improvement in coordination, transparency and free flow of information between all involved agencies. Most of the food laws and regulations are enforcement-oriented rather than anticipatory and preventive in nature. Food inspection is not properly enforced due to the increased volume of imported foods to be examined and the limited resources available for analyzing food samples. Based on the outcome of this study, a detailed action plan for the strengthening of the Kuwait food control system has been proposed. Such information will be invaluable for Kuwait and other GCC countries operating under similar conditions (Alomirah et al 2004 and 2010).

Food control systems in Arab Gulf Cooperation Council (GCC) countries

The Gulf Cooperation Council (GCC) is a regional organization that was established in May 1981 for the purpose of coordination, integration and inter-connection among the member countries in all fields in order to achieve unity. The member countries are. Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. In December 2007, the GCC Supreme Council announced the establishment of the GCC Common Market, which is designed to provide a single market for the whole GCC Community. The GCC are also considering the establishment of a monetary union with a single currency by 2010. In January 2003, GCC countries implemented the "GCC Unified Customs Law and Single Customs Tariff" (UCL). The UCL established a unified customs tariff of 5% on almost all imported foods. It also established a single entry point policy. This meant that a product entering any GCC member country would only pay duty at point of entry into the GCC then; it would be permitted to move freely in any GCC country (Al-Kandari and Jukes 2009).

The countries belonging to the Gulf Cooperation Council GCC are leading to increased harmonization of legislation and food control practices, despite their different approaches to food control management. The GCC countries are concerned with their food safety system due to a series of food safety scares in the countries from which many food products are imported (Al-Kandari and Jukes 2009). Countries are harmonizing their food standards with Codex and are moving towards an approach based on risk management. There is growing acceptance and increasing use of Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP), Good Agricultural Practices (GAP) and Hazard Analysis Critical Control Point

(HACCP) throughout the region (FAO 2005a). Assessing each of the five core components of a national food control system described by the FAO (food control management, food legislation, food inspection, official food control laboratories, food safety and quality information, education and communication (IEC)) will form the basis of this work (FAO 2005b).

Assessing food legislation

Food borne disease incidence in Gulf countries has appeared to decline due to a number of interventions, such as increased sanitation, milk pasteurization, canning foods, herd vaccination, economic development, use of refrigerators, improved housing, safer water supply, food monitoring and improved consumer information (Smith et al 2005). However, the decline in food borne incidence may actually be due to lack of reporting systems or under-reporting even with reporting systems in place. To prevent such food borne illnesses food law will need to specify the responsibilities of national authorities in integrating food controls at all stages of production and in all sectors, using the "farm to fork" principle (Al-Kandari and Jukes 2009).

Guide for controls on imported food. As one of the important requirements of the Customs Union, the GCC Supreme Council accredited in December 2006, a unified guide for controls on imported food. This guide would unify food import procedures across the six GCC members.

Unified GCC Trade Policy. In December 2005, the GCC Supreme Council adopted the Unified GCC Trade Policy. As part of the policy, the member countries would interact with the external world, including the WTO and the regional and international organizations as a single unit. This trade policy has therefore contributed towards the unification of GCC food policies, regulations and standards.

Food standards. Since the launch of the GCC Customs Union in 2003, member countries have negotiated and worked towards unifying their food standards. Each country currently applies either its own standard or a GCC standard, both of which are based on Codex (USTR 2009). In December 2007, the GCC approved new standards governing expiration periods and food labelling. All member countries are expected to adopt these standards as national standards in order to implement them (USTR 2009).

Some GCC food standards and regulations however, have not been completely in line with Codex such as some of the GCC shelf-lives which may differ from those defined in Codex due to the severe climate of the region in terms of temperature and humidity, differing greatly from climates of exporting countries (Al-Kandari and Jukes 2009).

Food inspection. Food inspection, as described by the FAO, is the examination of domestically-produced or imported food to ensure that it is handled, stored, manufactured, processed, transported, prepared, served and sold in accordance with the requirements of national laws and regulations, thus protecting the health and well-being of consumers (FAO 2006b). Food inspection in the GCC is carried out by officially recognized food inspection agents attached to different authorities. Inspection of imported and domestic foods occurs mainly through physical inspection and laboratory analysis (Al-Kandari and Jukes 2009).

Inspectors. The majority of inspectors in the GCC are public health inspectors who have completed secondary school and attended a multi-year course in public health inspection but with limited specific training in food inspection. These inspectors need to be updated about new trends in food and health inspection and need training in implementation of the HACCP system. Inspectors are also not provided with a detailed and comprehensive manual to follow as guideline in their daily work, although it would be an invaluable aid, especially to those with limited training. A manual of this kind would encourage standardized application of legal procedures, a correct administrative approach and uniformity in sampling techniques and inspection (Al-Kandari and Jukes 2009).

Risk analysis-based inspection. The objective of reducing risk to provide adequate consumer protection cannot be achieved effectively by merely sampling and analyzing the final food product. The introduction of preventive measures at all stages of the food chain is essential to achieve food safety, introducing Good Agricultural Practices (GAPs), Good Manufacturing Practices (GMPs), Good Hygiene Practices (GHPs), along with the application of Hazard Analysis Critical Control Points (HACCP). Although GMP and HACCP have been introduced throughout the GCC, they are not fully integrated in the domestic inspection systems which continue to focus primarily on end product control. There is a lack of a clear sampling policy specifying the number of samples and frequency of sampling of each type of food. The policy and the frequency of sampling should be based mainly on the risk associated with the consumption of each type of food, previous analysis results and the consumption rate. The UAE however, has successfully adopted the risk analysis approach (FAO 2005b).

Food control laboratories. A particular effort was made in GCC countries since the 1980s to continuously develop and update their laboratory services for food control. In most official food control laboratories of the region there is adequate infrastructure, facilities, equipment, supplies and access to calibration and maintenance. Food analysts however, lack proper training and experience. Most laboratories require official analytical methods and Standard Operating Procedures (SOPs) manual to be used as a guide for ensuring identity and integrity of analysis (Al-Kandari and Jukes 2009).

Most food laboratories in the Gulf countries lack internationally recognized accreditation. Few laboratories in the region have introduced a comprehensive quality assurance system in their analytical work which is essential for seeking accreditation. The GCC Standard Organization has organized a scheme for accreditation of food

laboratories according to international standards. The requirements for accreditation have already been published and GCC laboratories are making progressive efforts to fulfil these requirements and achieve accreditation (FAO 2005b).

Information Education and Communication. The importance of Information, Education and Communication (IEC) in food control is gaining recognition and acceptance in the Gulf region. GCC countries need to continue raising awareness in the form of workshops, campaigns and conferences. Adequate educational programs for the public and food handlers should be provided on different aspects of food safety such as basic food hygiene and handling. These should be carried out in different languages to be understood by the expatriate food handlers, which constitute a high percentage in GCC restaurants, factories and homes. Food handlers often have little information about food contamination risks and how to avoid them. The majority of food handlers in GCC countries are low socioeconomic expatriates coming from the Indian subcontinent and Far East countries. Adequate educational programs for the public and food handlers should be provided on different aspects of food safety such as basic food hygiene and handling. These should be carried out in different languages to be understood by the expatriate food handlers, which constitute a high percentage in GCC restaurants, factories and homes (Al-Kandari and Jukes 2009).

Discussion

The food control systems in GCC countries have improved over the past decade; however, these systems still appear inefficient in providing the necessary protection to the consumer. One of the main problems facing most GCC countries is the division of responsibility for food control among various government agencies/ministries. Where more than one agency is involved in food control activities, the first step towards improvement is to define the role and tasks of the different agencies involved must be defined, keeping in mind the need to cover all stages of the food chain. This will help avoid overlapping and conflict of responsibilities. Reliable information on hazards associated within the food continuum in GCC countries is not available because of the deficiency of food borne disease surveillance where under-reporting is common. It is necessary for GCC governments to consider new legislation on food hygiene and on implementation of the HACCP system as a more effective and preventive food safety measure (Al-Kandari and Jukes 2009). GCC countries by becoming members of the WHO, have become committed to achieving global standards in food safety and have been following Codex Alimentarius guidelines for food safety. The introduction of unified risk-based food safety legislation in these countries will improve food security and public health, and lead to improved international trade opportunities. Food inspection in most of the GCC countries still relies on end product testing. Inspection has concentrated more on general hygienic and sanitation aspects without taking into consideration many other sources of food contamination. Inspection should focus on storage and preservation of foods, cooking methods, cleaning materials and methods, sterilization and disinfection, kitchen design and equipment, etc. GCC governments are recommended to implement a risk-based approach and apply electronic reporting of food imports as in the UAE, to improve the overall safety of food.

Conclusions and recommendations

As the GCC countries have similar demographic, cultural and environmental characteristics, cooperation and coordination among theses countries in food safety are essential to help improve food safety and enhance readiness to plan and react to food emergencies. The large proportion of imported food provides a key challenge to the authorities but the willingness to apply international standards should enable the GCC countries to achieve the necessary controls. The coordination, transparency and free flow of information between all involved agencies should be improved.

Regarding to food control system in Kuwait, its recommends a more coordination approach to food safety with significant increase in the use of risk analysis methods to target enforcement and Guidelines should be achieved to assess capacity building in the core components. Assessing each of the five core components of a national food control system described by FAO (food control management, food legislation, food inspection, official food control laboratories, food safety and quality information, education and communication) (FAO 2005a). National Plans of Action for Nutrition should be submitted to the Food and Agriculture Organization of the United Nations, to determine common themes related to food safety and quality to improve the food hygiene, control chemical contaminants and focus on reducing diseases through public education about food and water hygiene. Also moving into or participating in market economies discuss improvements need in the food control system, with many concentrating on use of Codex Alimentarius food standards to facilitate trade. Education of farmers, food manufacturers, food inspectors, and consumers are essential in the system building (Hillers 1997). Food laws and regulations should be anticipatory and preventive in nature oriented and should be up-grading regularly. Food inspection is not properly enforced and need more training and awareness. Improving the hygienic conditions on the dairy farms can greatly ameliorate the sanitary status of the raw milk and pasteurized milk being produced in the country. Regarding to FM1, in spit of the contamination of milk and milk products with AFM1 does not appear to be a serious health

problem in Kuwait, but stress the necessity to monitor regularly the occurrence of aflatoxins in the animal feeds responsible for current limited contamination and to note rapidly any worsening in the situation. Also regular further investigation of the presence of FM1 in milk, milk products, and dairy cattle feed should be continuo. Proper intervention programs should be designed and implemented to control the prevalence of nutritional disorders prevailing in preschool children in Kuwait, such as stunting, wasting, anaemia and obesity associated with overfeeding and excessive food intake (Forbes 2007). Particular emphasis should be placed on the food consumption patterns of Kuwaiti children and health implication, if any, that may be associated with consumption of high levels of artificial colour additives from food (Amine et al 1996). Also, it is highly recommended that dietary fibre be increased, increasing the intake of fruits and vegetables. A partial substitution of the animal fat with vegetable oil in certain Kuwait dishes is being proposed. The high consumption of certain Kuwaiti dishes, low in essential nutrients such as iron and zinc, Vitamin A, C and E, should be modified. The consumption of Kuwaiti dishes based on shrimp, lamb meat, dairy, and sweets rich in eggs is reduced. Regarding to pesticides residue, a continuous monitoring and follow-up of changes in the levels of pesticides and other contaminants focusing particularly on food imported from highly risk sources should be implemented. The acquired data highlighted the necessity to routinely monitor these residues particularly in food spice commodity for ethion contamination in order to avoid the exposure to these harmful residues and, moreover, confirmed the importance of such pesticide monitoring programme to reduce the incidence of illegal residues in red chilli peppers. Also, it needs to follow up the level of 3-H carbofuran in fruit samples, and more projects has to be achieve for all pesticides residues at all food items. Regarding to PAH, The data concluded that they did not presented a health risk due to the fact that they are below the reference which established by the European Union law. Regarding to drug residues, veterinary antimicrobial drugs, it's a vital to put in places the appropriate systems to ensure that veterinary antimicrobial drugs are manufactured, marketed, distributed, prescribed, use of antimicrobials in food producing animals, and used responsibly. These systems are adequately audit for the responsible use of these products by all those involved. The significant presence of antimicrobial residues, particularly chloramphenicol, tetracyclines in raw and pasteurized milk, and chicken clearly implies the misuse of antimicrobial drugs in animal farms in Kuwait and neighboring countries, and implies the need for stricter regulations on antimicrobial drug usage in the dairy industry. So scientists call for prudent use of antibiotics, monitored by local regulatory enforcement agencies. Regarding to synthetic colours presented at many saffron samples, the tracing of the source of adulteration should be carried out to control the market. Regarding to HMF at honey and depending on the data supplied which cleared the requirement of more discussion about the maximum level of HMF in Kuwait standard specification.

Finally the present review is just a beginning to summarize the food safety status in Kuwait and needs to regular update to help whom car in human health strategy.

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