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Research Article
Food Consumption Patterns and Trends in The Gulf Cooperation Council

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Abstract

Background and Objective: Qualitative and quantitative changes in diets represent the main characteristics of the dietary changes in Gulf countries. The objective of this paper is to describe and examine the patterns, growth rates and trends of food supply and consumption in Gulf Cooperation Council countries during the period of 1961-2013. **Materials and Methods:** The study depended mainly on secondary data derived from annual food balance sheets produced by the FAO. Trend analysis, annual growth rates, descriptive statistics and analysis of variance and means comparison were used to analyze the collected data. **Results:** A change in the consumption patterns, trends and annual growth rates in the GCC countries was noticed. These changes were manifested by the following facts: There was a low rate of increase in the cereal supply relative to other food items, The vegetable supply annual growth rate was highest in the UAE (4%) compared to the KSA (1.4%) and Kuwait (1%), The fruit supply showed an increasing trend in the KSA and a decreasing trend in Kuwait and the UAE, The shares of sugar and sweeteners in the food supply in KSA and Kuwait show increasing patterns, contrary to the situation in the UAE, Vegetable oils and animal fats supplies showed increasing patterns in both KSA and Kuwait, with contrasting trends in the UAE. **Conclusion:** There is a shift in dietary energy supply, protein and fat preference towards vegetal sources in the UAE and to animal products in the KSA and Kuwait. Moreover, the macronutrient contribution to caloric value showed disparity among GCC countries.

Key words: Consumption patterns, dietary energy supply, food supply, Gulf Cooperation Council, Macronutrients

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Qualitative and quantitative changes in diets represent the main characteristics of the dietary changes in transitional nutrition. These changes include the structuring of the diet towards a higher energy density diet with a greater role of fat and added sugars in foods, higher intake of saturated fat and reduced intakes of complex carbohydrates and dietary fruits and vegetables[1].

The Gulf Cooperation Council (GCC) countries, with a total population of 40 million, are among the world's richest in terms of oil and gas reserves and per capita wealth. However, these countries import up to 90% of their food requirements. This could be attributed to water shortages and the lack of arable land. Therefore, the growth and outlook of the food sector is of substantial importance for these countries. Domestic production is insufficient to meet the current requirements and food imports in the GCC region stood at 25.8 billion USD in 2010. High dependence on imports makes the GCC food supply very vulnerable and highly dependent on the world food market[2] .

During the last four decades, the Arab Gulf countries experienced a rapid and drastic change in their socioeconomic situation, food consumption patterns and lifestyle and health status. This is mainly attributed to the sharp increase in income due to accumulated oil revenues. Nevertheless, undernutrition and micronutrient deficiencies still exist among vulnerable groups; diet-related chronic diseases have become the main health problems while communicable diseases have diminished[3].

Many factors interact in different, complex ways to influence and shape dietary consumption patterns and diet composition and content. These factors include income, prices, individual preferences and beliefs, cultural traditions and geographical, environmental, social and economic factors. Major shifts in dietary patterns are occurring, such as a shift in consumption of basic staples towards more diversified diets. Considerable health consequences have accompanied these changes in food consumption at a global and regional level. Populations in those countries undergoing rapid transitions are experiencing a nutritional transition. The diverse nature of this transition may be the result of differences in sociodemographic factors and other consumer characteristics. Among other factors, including urbanization and food industry marketing, the policies of trade liberalization over the past two decades have implications for health by virtue of being a factor in facilitating the 'nutrition transition' that is associated with rising rates of obesity and chronic diseases, such as cardiovascular disease and cancer[4] .

A global burden of disease projects has estimated that there are 2.7 million deaths worldwide (1.8% of global disease burden), which can be attributed to inadequate food consumption. If the intake of fruits and vegetables by individuals increases, the global burden will decrease by 31% for ischemic disease, 19% for strokes, 19% for stomach cancer, 20% for esophageal cancers, 12% for lung cancers and 2% for colorectal cancers[5].

Several sources of data may be used when examining patterns in both the supply and consumption of foods for making worldwide comparisons or examining international trends over time. Such data may be derived from food balance sheets (FBSs), household budget surveys, or individual dietary surveys (IDSs). Each of these methods have their own merits depending on the particular outcome desired[6].

Food balance sheets are constructed by the FAO from national accounts of the supply and use of foods. They are calculated from the food produced in and imported into countries minus the food exported, net of imports, fed to animals or otherwise not available for human consumption, divided by the population size[7]. FBS data provide information about average availability per person; that is, they relate simply to the quantities of food reaching the consumer (i.e., a measure of availability). FBSs, while describing consumption of foods per capita of the population for a country, do not represent the amount of food actually consumed and will almost invariably result in an overestimation in food consumption compared with dietary surveys at the individual level[8] . Annual FBSs tabulated regularly over a period of years (FAOSTAT database) show trends in the overall national food supply.

The objective of the present paper is to describe and examine the patterns, growth rates and trends of food supply and consumption in GCC countries during the period from 1961-2013.

This is achieved by analyzing and assessing the following: patterns, growth rates and trends in food, fat and protein supplies (g capita^{-1} day^{-1}); dietary energy supplies (kcal capita^{-1} day^{-1}); vegetal and animal sources of energy, protein and fat in the diet and the contribution of macronutrients (fat, protein and carbohydrates) to the energy supply.

MATERIALS AND METHODS

The data used in the paper primarily depend on the analysis of the food balance sheet that has been compiled and analyzed by the FAO in collaboration with the KSA, Kuwait and UAE governments during the study period (1961-2013).

Moreover, data from the Arab Organization for Agricultural Development and national institutions were collected. Country-specific food balance sheets (FBS) provide information on the supply and utilization of many different commodities. FBSs provide both food supply and utilization data. Food supply includes production, imports, stock changes and exports, while utilization covers animal feed, seed, processing, waste, other uses and food. From these data, the per capita supply of energy, protein and fat was calculated for all food commodities[9]. Analysis of FBS data provides an average for the whole country and not the actual per capita availability. One of the main shortcomings of this data is that the analysis of the food balance does not consider the regional, socio-economic and seasonal variability of food availability.

The study covered three countries of the GCC (KSA, Kuwait and UAE) based on the availability of their annual balance sheets. The study parameters included the per capita food supplies in terms of quantity (g capita^{-1} day^{-1}), dietary energy supply (DES) (kcal capita^{-1} day^{-1}) and protein and fat contents (g/c/d). Additionally, the extent to which vegetal and animal sources contributed to energy, protein and fat in the diet as well as the contribution of macronutrients to the energy supply were included. Trend analysis, annual growth rates, descriptive statistics and analysis of variance and means comparisons were used to analyze the collected data.

RESULTS AND DISCUSSION

Food consumption patterns: The people of Eastern Arabia's Gulf Coast are very traditional and eat the same foods they have eaten for centuries. The basic ingredients of their food are the same: fava beans, wheat, rice, yogurts, dates and chicken are staple foods[10]. Available data (FAO STAT), in addition to a very few local studies, showed differences in food availability, climate and regional food habits and traditions that resulted in regional variation in food consumption patterns in GCC countries. However, there was a nutritional transition 3-4 decades ago, where there were substantial shifts to the modern western diet and lifestyles; urbanization is mostly pronounced in the GCC countries and more people are shifting to living in large cities[10].

Food supply: Food consumption is one of the main variables for assessing and evaluating food security and helps in designing and implementing food and nutrition security policies that are aimed at achieving food self-sufficiency in each country via domestic production and imports of food items from other countries.

During the last four decades, there were many changes in food consumption patterns in the Eastern Mediterranean countries. These changes have great consequences on the nutritional status of the communities of these countries. The combination of changes in consumption patterns, together with the changes in lifestyle by many people in this region, leads to an increase in diet-related chronic diseases. These diseases have become major public health problems, which account for more than 50% of the mortality in most of these countries[11].

During the period of 1961-2013, the food supply trends in the GCC countries showed increasing patterns. The trend equations revealed that the food supply increased by 140, 101 and 56 g capita^{-1} day^{-1} in KSA, Kuwait and the UAE, respectively. The food supply in KSA, Kuwait and the UAE increased from 881, 1711 and 1381 g capita^{-1} day^{-1} in 1961-1970 to 1662, 2226 and 1810 g capita^{-1} day^{-1} in 2011-2013, respectively (Fig. 1).

Based on the food supply (g capita^{-1} day^{-1}), the annual per capita food supply (kg capita^{-1} year^{-1}) was tabulated for the three countries. The annual food supply in the GCC countries showed that, in the KSA, the annual per capita supply increased from 322 (kg capita^{-1} year^{-1}) in 1961-1970 to approximately two-folds that value in 1981-1990, then dropped to 582 in 1991-2000 and thereafter starting to increase during the period of 2001-2013 (Table 1).

In Kuwait, the food supply steadily increased from 625 kg capita^{-1} year^{-1} in 1961-1970 to a peak of 812 in 2011-2013 (Table 1). The food supply in the UAE showed fluctuation patterns as the supply increased from only 500 kg capita^{-1} year^{-1} in 1961-1970 to 1000 kg capita^{-1} year^{-1} in 1981-1990, after which the supply started to decrease until it reached 661 kg capita^{-1} year^{-1} in 2011-2013. According to the GCC Food Industry Report[12], the major driving factors for increasing food demand in the GCC, among others, include population growth, increasing affluence and rising tourist and expatriate inflows within the GCC. On the other hand, the arid climate, less arable land and water scarcity are the major

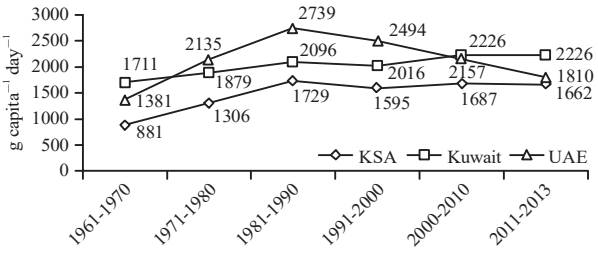

Fig. 1: Food supply trend (g capita^{-1} day^{-1}) in selected GCC countries, 1961-2013

Table 1: Food supply (kg capita^{-1} day^{-1})and the share of selected food items in the food supply in GCC countries

GCC		1961-1970		1971-1980		1981-1990		1991-2000		2000-2010		2011-2013	
Food supply	KSA	322		477		631		582		616		607	
(kg capita^{-1} year^{-1})	KWT	625		686		765		736		812		812	
	UAE	504		779		1000		910		787		661	
		Value	%	Value	%	Value	%	Value	%	Value	%	Value	%
Cereals	KSA	136	42	123	26	142	23	161	28	166	27	154	25
	KWT	131	21	123	18	123	16	121	16	167	21	159	20
	UAE	170	34	166	21	152	15	146	16	169	22	159	24
Sugar and sweeteners	KSA	12	4	19	4	31	5	28	5	32	5	32	5
	KWT	34	5	44	6	41	5	35	5	42	5	38	5
	UAE	37	7	42	5	38	4	35	4	28	5	13	5
Vegetables oils	KSA	3	1	6	1	14	2	14	2	15	3	19	3
	KWT	11	2	9	1	13	2	12	2	19	2	19	2
	UAE	0	7	5	18	12	27	11	28	7	20	4	12
Vegetables	KSA	56	17	108	23	139	16	120	21	99	16	100	16
	KWT	144	23	145	21	185	24	174	24	182	22	178	22
	UAE	32	11	139	14	271	10	258	13	155	13	76	15
Fruits	KSA	54	17	101	23	113	22	97	21	95	16	90	17
	KWT	82	23	94	21	99	24	88	24	63	22	87	22
	UAE	34	7	122	16	156	16	128	14	85	14	35	14
Milk	KSA	35	17	67	21	105	18	74	17	80	16	96	15
	KWT	124	13	159	14	170	13	163	12	138	8	141	11
	UAE	117	23	163	21	187	19	151	17	95	17	42	17
Meat	KSA	9	11	23	14	43	17	45	13	52	13	60	16
	KWT	41	20	49	23	60	22	63	22	93	17	85	17
	UAE	59	12	65	8	87	9	80	9	58	10	21	9
Animal fat	KSA	1	3	2	5	2	7	2	8	2	8	2	10
	KWT	2	7	2	7	3	8	3	9	4	11	3	10
	UAE	19	4	9	1	4	0	4	0	4	1	2	0
Pulses	KSA	3	1	3	1	4	1	3	1	4	1	6	1
	KWT	6	1	6	1	5	1	7	1	18	2	19	2
	UAE	0.4	0.1	6	1	9	1	14	2	10	2	9	4

limiting factors for food production in these countries and make them heavily reliant on imports for the realization of food security. However, the GCC's plentiful oil revenues have supported its food imports and empowered the governments of these countries to engage in multibillion-dollar investments towards improving the food security status[12].

Cereals, fruits, meat, milk and vegetables constitute the main food groups in terms of supply for human consumption in GCC counties (Table 1). Cereals contributed 136, 131 and 170 kg capita^{-1} year^{-1} from 1961-1970, in KSA, Kuwait and the UAE, respectively. Then, the supplies showed increasing patterns reaching 154, 159 and 159 kg capita^{-1} year^{-1} for the three countries in 2011-2013, respectively. Although, the share of cereals in the food supply (kg capita^{-1} year^{-1}) showed increasing patterns, the percentage share of cereals showed a decreasing trend in the three countries. This indicates that the rate of increase in cereal consumption is relatively low compared to the other selected food items, indicating a change in consumption patterns in the GCC. The annual growth rate of the cereal supply (kg capita^{-1} year^{-1}) between 1961 and 2013 amounted to only 0.3, 0.4 and 0.04% for Saudi Arabia, Kuwait and the UAE, respectively (Table 2).

Recent epidemiological advances suggest that regular consumption of fruits and vegetables in adequate amounts could help prevent major chronic diseases such as cardiovascular diseases and certain cancers[13-16].

The adequate fruit and vegetable intake was defined as 400-500 g per day (g day^{-1}) or 5 servings of fruit and/or vegetables (80 g each)[17].

The vegetable supply (kg capita^{-1} year^{-1}) in the GCC countries showed fluctuating patterns. For instance, in the KSA, the vegetable supply increased from 56 kg capita^{-1} year^{-1} in 1961-1970 to 139 in 1981-1990 and then dropped to 99 in 2001-2010. In 1981-1990, vegetable supply (kg capita^{-1} year^{-1}) in the UAE increased almost nine-fold relative to that during 1961-1970, as the vegetable supply increased from 32-258 kg capita^{-1} year^{-1} and then dropped to 76 kg in 2011-2013. The vegetable supply in Kuwait showed an increasing trend, as the supply of vegetables increased from 144 kg capita^{-1} year^{-1} in 1961-1970 to approximately 178 in 2011-2013.

The annual per capita vegetable supplies between 2011-2013 in the KSA (100 kg) and the UAE (76 kg) were below the averages for both the Arab countries (128 kg) and the

Table 2: The annual growth rate of food items in the food supply and contributions of vegetal and animal products to the DES, protein and animal fat supplies

	KSA			KWT			UAE		
kg capita^{-1} year^{-1}	1961	2013	CAGR	1961	2013	CAGR	1961	2013	CAGR
Cereals	133	154	0.3	119	147	0.4	155	159	0.04
Sugar and sweeteners	7	32	3.0	33	39	0.3	36	37	0.1
Vegetables	51	105	1.4	130	223	1.0	8.7	70	4.0
Fruits	50	92	1.2	65	109	1.0	29	117	2.7
Milk	28	84	2.1	112	158	0.6	143	133	-0.1
Meat	9	64	3.7	45	83	1.2	75	59	-0.5
Animal fat	0.8	4.84	3.5	1.7	2.99	1.07	21.6	2.58	-3.9
Pulses	2	6	2.0	4	28	3.8	1	238	10.9
Food supply (kcal capita^{-1} day^{-1})									
Total	1719	3255	1.2	2410	3501	0.7	2891	3280	0.2
Vegetal	1583	2736	1.0	1926	2795	0.7	1750	2721	0.8
Animal products	136	520	2.6	484	706	0.7	1141	559	-1.3
Protein supply quantity (g capita^{-1} day^{-1})									
Total	46	92	1.3	72.6	108	0.8	87	105	0.3
Vegetal	38	52	0.6	39	55	0.6	32	63	1.3
Animal products	8	40	3.1	34	54	0.9	55	42	-0.5
Fat supply quantity (g capita^{-1} day^{-1})									
Total	27	108	2.7	72	117	0.9	98	87	-0.2
Vegetal	17	73	2.8	39	70	1.1	4	53	5.0
Animal products	10	35	2.5	33	47	0.7	94	34	-1.9

CAGA: Cumulative annual growth rate

world (136 kg); however, the vegetable supply in Kuwait (2011-2013) exceeded both Arab countries and global averages.

The annual growth rate of the vegetable supply between 1961 and 2013 was highest in the UAE (4%) compared to the KSA (1.4%) and Kuwait (1%) (Table 2). The average fruit supply (2011-2013) in the three GCC countries outnumbered the Arab countries average between 2007-2012 (79.2 kg capita^{-1} year^{-1}) as well as the global average (74 kg capita^{-1} year^{-1})[18] .

The fruit supply in GCC countries was widely different. In the KSA, the fruit supply increased from 54 kg capita^{-1} year^{-1} in 1961-1970 to reach the peak of 113 kg capita^{-1} year^{-1} in the 1980s and then started to drop to 90 kg capita^{-1} day^{-1} in 2011-2013 (Table 1). The fruit supply in Kuwait and the UAE showed a decreasing trend, while an increasing trend was noticed in Saudi Arabia.

The milk supply (kg capita^{-1} year^{-1}) showed an increasing trend in the KSA and Kuwait during the periods of 1961-70 and 2011-2013, contrary to the UAE, where a decreasing trend was shown. In the UAE, the milk supply steadily decreased from 187 in the 1980s to 95 during 2001-2010 and then to 42 kg capita^{-1} day^{-1} from 2011-2013. The milk supply annual growth rate between 1961-2013 was 2% in the KSA, 0.6% in Kuwait and -0.1% in the UAE (Table 2).

The milk supply (2011-13) in the KSA surpasses the average of the Arab countries (81.7 kg capita^{-1} year^{-1}) and is below the world average (109 kg capita^{-1}); however, in Kuwait, the average milk supply for the same period exceeded both the Arab countries averages and global averages.

The share of sugar and sweeteners in the food supply in the KSA and Kuwait shows an increasing pattern, contrary to the situation in the UAE, where sugar and sweetener supply decreased from 42 kg capita^{-1} year^{-1} in 1971 to less than one-third of that value in 2011-13 (Table 1).

The vegetable oil supply showed an increasing pattern in GCC countries during the study period. A drastic change in the vegetable oil supply was noticed in the KSA as it increased from 3 kg capita^{-1} year^{-1} in 1961-1970 to more than six-fold that value in 2011-2013. On the other hand, in the UAE, the vegetable oil supply decreased from 12 kg capita^{-1} year^{-1} in the 1980s to only one-third of that value in 2011-2013 (Table 1). This situation is also true for animal fat, where the supply was increased in both the KSA and Kuwait, contrary to situation in the UAE where the animal fat decreased from 19 kg capita^{-1} year^{-1} in the 1960s to only one-tenth of that value in 2011-2013. The annual growth rate of the animal fat supply from 1961-2013 was 3.45% for the KSA as the supply increased from 0.8 in 1961-4.84 kg capita^{-1} year^{-1} in 2013 (Table 2). The animal fat supply in Kuwait showed an annual growth rate of 1% during the same period. In contrast, a negative annual growth rate of -3.9% occurred from 1961-2013 in the UAE, where the animal fat supply decreased from 21.8 kg capita^{-1} year^{-1} in 1961 to only 2.58 kg capita^{-1} year^{-1} in 2011-2013 (Table 2).

In GCC countries, the meat supply (kg capita^{-1} year^{-1}) varies from one country to another. In the KSA, the meat supply increased from nine kg capita^{-1} year^{-1} in the 1960s to 60 kg capita^{-1} year^{-1} during 2011-13. In Kuwait, the meat supply in 2011-2013 was more than double that of the 1960s supply. Moreover, the annual growth rate of the meat supply between 1961 and 2013 was 3.75, 1.2 and -0.5% in the KSA, Kuwait and the UAE, respectively. The meat supply in the KSA and Kuwait during 2011-13 outnumbered the averages of the Arab countries (29.5) and the world (42.8). While in the UAE, the situation was reversed, where the average meat supply was below both the Arab countries average and the world average in 2013.

The pulse supply in the KSA, Kuwait and the UAE increased from 3, 6 and 0.4 in 1961-1970 to 6, 19 and 9 kg capita^{-1} year^{-1} in 2011-2013, respectively (Table 1). In Kuwait, the average pulse supply in 2011-2013 increased by more than three-fold compared to 1961-1970 levels. The highest annual growth rate of the pulse supply was reported in the UAE (11%), followed by Kuwait (3.8%) and the KSA (2%) (Table 2).

The supply of sugar and sweeteners (kg capita^{-1} year^{-1}) showed an increasing trend in the KSA and Kuwait; however, the situation was contrasting in the UAE, where the sugar and sweetener supply decreased from 37 (kg capita^{-1} year^{-1}) in 1961-1970 to only approximately one-third of that in 2011-2013 (Table 1).

Dietary energy supply: In general, dietary energy, measured in kcal capita^{-1} day^{-1}, has been steadily increasing in all regions of the world. Globally, the percentage increase in per capita energy availability was 19% from 1964 to 1999, from 2358-2803 kcal, respectively [2]. The change has, however, varied between regions.

According to FAO/WHO expert consultation[19] regarding carbohydrates, approximately 55% of energy should be derived from different carbohydrate sources that are rich in non-starch polysaccharides and have a low glycemic index. Moreover, adults must consume different food groups, such as cereals, vegetables, legumes and fruits.

The dietary energy supply in GCC selected countries increased from the period of 1961-1970 to 2011-2013 (from 1843, 2572 and 2803 kcal capita^{-1} day^{-1} to 3209, 3420 and 3240 kcal capita^{-1} day^{-1}, respectively). (Fig. 2).

According to FAO Statistics, animal products contributed approximately 17% of the energy sources (kcal capita^{-1} day^{-1}), 38% of protein and 45% of the fat supply (g capita^{-1} day^{-1}). The Arab Organization for Agricultural Development statistics revealed that in Arab countries, animal products contribute

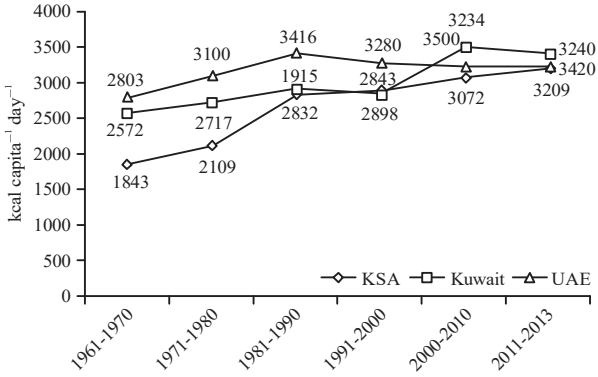

Fig. 2: GCC dietary energy supply trend (kcal capita^{-1} day^{-1}), 1961-2013

approximately 22% of the food supply (g capita^{-1} day^{-1}), 15% of the dietary energy supply (kcal capita^{-1} day^{-1}) and approximately 27% of protein and fat supplies (g capita^{-1} day^{-1})[18].

The percentage of vegetables in the dietary energy supply slightly decreased in the KSA from the periods of 1961-1970 to 1981-1990 (from 92-84%). From 1991-2000 to 2001-2010, the percent share of vegetables in the dietary energy supply remains similar (i.e., 86%). In Kuwait, the percent share of vegetables in the dietary energy supply slightly decreased from 1961-1970 to 1991-2000 (from 81-77%) and then increased (79%) from 2011-2013. The percent share of animal products in the dietary energy supply slightly increased in the KSA and Kuwait. In the UAE, the percent share of vegetal products increased, while that of animal products decreased from 1961-1970 to 2011-2013 (Table 3).

The results revealed that energy intakes ranged from 1719 kcal per capita per day in 1961-3255 kcal per capita per day in 2013 in the KSA, with an annual growth of 1.2%. Between 1961 and 2013, the annual growth rate of the animal products (2.6%) outnumbered the annual growth rate of the vegetal products (1%). However, in Kuwait, the total, vegetal and animal products showed a comparable annual growth rate of 0.7% of the energy supply per capita per day. However, in the UAE, the annual growth rate of the energy supply derived from animal sources is declining (-1.3%), contrary to that of vegetal sources (0.8%) (Table 2).

These results indicate that the share of dietary energy supplied from animal origin increased in the KSA and Kuwait and declined in the UAE. It is noteworthy that the KSA has the highest annual growth rate of energy supplies from both animal and vegetal sources (Table 2).

Table 3: Percentage share of vegetal and animal products in dietary energy, protein and fat supplies in KSA, Kuwait and UAE (1961-2013)

		Values						AS %					
		1961-1970	1971-1980	1981-1990	1990-2000	2001-2010	2011-2013	1961-1970	1971-1980	1981-1990	1990-2000	2001-2010	2011-2013
Dietary energy supply (kcal capita^{-1} day^{-1})	KSA	1694	1827	2379	2501	2644	2690	92	87	84	86	86	84
Vegetal	Kuwait	2083	2140	2232	2182	2805	2787	81	79	77	77	77	79
	UAE	1842	2216	2450	2475	2568	2722	65	71	72	76	79	84
	KSA	149	283	456	397	433	519	8	13	16	14	14	16
Animal products	Kuwait	489	578	683	661	755	683	19	21	23	23	21	20
	UAE	971	891	938	772	647	517	35	29	28	24	20	16
Protein supply (g capita^{-1} day^{-1})	KSA	39	38	46	50	52	51	81	67	59	64	61	56
Vegetal	Kuwait	43	41	42	42	53	52	56	51	47	48	50	50
	UAE	35	44	50	53	57	63	44	47	45	49	52	61
	KSA	9	19	32	29	33	39	19	33	41	36	39	43
Animal products	Kuwait	34	40	47	46	54	52	44	49	53	52	50	50
	UAE	45	50	59	52	47	39	57	54	53	48	44	38
Fat supply (g capita^{-1} day^{-1})	KSA	20	28	53	53	57	69	67	60	64	67	69	67
Vegetal	Kuwait	41	39	49	48	68	70	56	51	53	53	57	61
	UAE	6	28	52	49	44	57	7	29	43	47	51	64
	KSA	10	19	29	26	28	34	33	40	36	33	33	33
Animal products	Kuwait	32	37	44	42	51	45	44	49	47	47	43	39
	UAE	81	68	68	55	42	32	93	72	57	53	48	36

Table 4: Percentage shares of the DES of selected food items (kcal capita^{-1} day^{-1})

Food Item		1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2013
	KSA	66.7	52.6	45.9	50.6	49.6	44.5
Cereals	Kuwait	43.4	39.4	36.8	37.4	42.2	41.7
	UAE	48.6	39.3	30.9	34.8	42.2	42.7
Sugar and sweeteners	KSA	6.2	8.7	10.8	9.6	10.3	9.7
	Kuwait	13.5	15.9	13.7	12.3	11.7	10.6
	UAE	12.7	13.5	11.5	10.8	11.3	10.8
Vegetables	KSA	17.0	23.0	16.0	21.0	16.0	16.0
	Kuwait	23.0	21.0	24.0	24.0	22.0	22.0
	UAE	11.0	14.0	10.0	13.0	13.0	15.0
Fruits	KSA	9.8	11.4	8.1	7.2	7.2	6.6
	Kuwait	4.5	4.5	4.1	3.9	2.7	3.7
	UAE	2.6	6.1	7.4	6.6	5.4	4.4
Milk	KSA	3.3	5.1	5.6	4.5	4.4	5.0
	Kuwait	6.1	7.6	7.8	8.4	6.3	5.9
	UAE	7.7	9.0	9.4	7.8	6.8	6.0
Meat	KSA	2.9	5.3	7.0	6.6	6.8	7.5
	Kuwait	9.2	9.4	10.5	10.6	11.0	10.2
	UAE	10.2	10.6	13.1	11.5	9.4	6.8
Animal fat	KSA	1.1	1.7	1.7	1.2	1.2	1.9
	Kuwait	1.3	1.7	2.2	1.7	1.9	1.4
	UAE	14.0	6.0	2.6	2.3	1.8	1.2
Pulses	KSA	1.3	1.2	1.2	1.1	1.3	1.8
	Kuwait	2.2	2.1	1.8	2.2	0.4	0.2
	UAE	0.1	1.9	2.5	4.0	4.0	7.5

Energy density is one of the most important qualities of food with regard to both overweight and malnourished persons. If the energy density is low, the food becomes too bulky and the person will not be able to eat adequate amounts and therefore will be susceptible to becoming underweight. At the same time, if the energy density is high, the person will consume extra energy, which can lead to people becoming overweight[20]. The proposed nutrient densities for the family diet depend on the consumption of adequate amounts of energy for adults and adolescents. If intake for adolescents or adults is under 2000 kcal day^{-1}, it is unlikely that their vitamin and mineral needs will be met[21] .

In the 1960s, cereals contributed to approximately two-thirds of the dietary energy supply in the KSA (66.7) and approximately half of the DES in both Kuwait (43.4%) and the UAE (48.6%). As the data in (Table 4) show, the share of the dietary energy supply derived from cereals was only one-third of the DES in the 1980s in the three countries. Then, the share increased to approximately two-fifths of the DES in the KSA (44.5%), Kuwait (41.7%) and the UAE (42.7%) in 2011-2013.

During the last five decades (1961-2013) in GCC counties, the annual growth rates of the energy supply attained from cereals, meats, sugars and sweeteners, vegetables, fruits, milks and animal fats show varying patterns and trends. The highest cereal annual growth rate was reported in Kuwait (0.5%). In the UAE, the annual growth rate of the energy obtained from vegetables, fruits and pulses was the highest across the GCC countries. Moreover, in the UAE, the shares of dietary energy supplied from milk, meat and animal fat have decreased over time, as indicated by negative annual growth. In contrast, the highest annual growth rate of energy derived from sugars and sweeteners, meats, milks and animal fats was reported in the KSA (Table 2). Thus, it could be concluded that there was a change in dietary supply preference towards vegetal sources in the UAE and towards animal products in the KSA. In Kuwait, the annual growth rate of vegetal and animal products as sources of dietary energy supply remained relatively unchanged during the last five decades.

Protein supply: Dietary protein content and quality are of major importance in the treatment of malnourished children. If the protein content, quality, or availability is too low, it will limit growth and thereby recovery. If the intake is above the requirement, the surplus protein will be metabolized into energy, which is not an energy-efficient process. At present, no upper limit on protein intake has been set, yet animal and human data suggest that excessive protein intake has an adverse effect on kidney function[20]. Figure 3 demonstrates an increasing trend in protein consumption in GCC countries from 1961-1970 to 2001-2009 (48, 76, 80 g capita^{-1} day^{-1} to 90, 105, 103 g capita^{-1} day^{-1}, respectively).

According to the WHO/FAO[21], there has been increasing pressure on the livestock sector to meet the growing demand for high-value animal protein. The world's livestock sector is

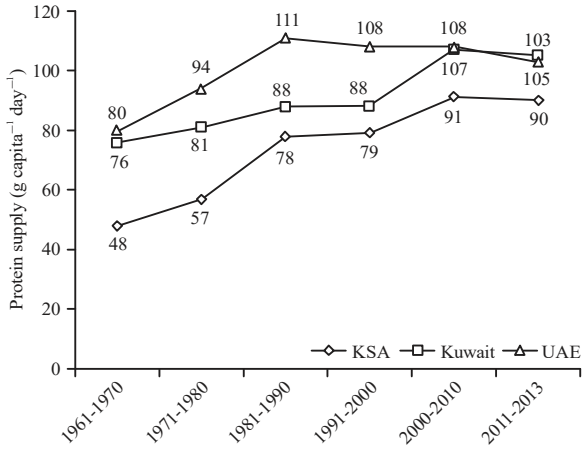

Fig. 3: GCC protein supply trend (g capita^{-1} day^{-1}), 1961-2013

growing at an unprecedented rate and the driving force behind this enormous surge is a combination of population growth, rising income and urbanization.

During the period from 1961-2013, the lowest annual growth rate of the protein supply in GCC countries was recorded in the UAE (0.3%), while the highest occurred in the KSA (1.3%). Protein supplied from animal products showed an increasing trend with an annual growth rate of 3.1% in the KSA and 0.9% in Kuwait and a downward annual growth of 0.5% in the UAE. On the other hand, the highest annual growth rate of protein derived from vegetal sources was recorded in the UAE, while the lowest rate was reported in the KSA and Kuwait (Table 2).

A change in the consumption patterns in GCC countries was noticed as some countries such as the UAE increased the consumption of protein from vegetal sources and decreased consumption of animal protein. In the KSA, the reverse was true, where the growth rate of protein from animal origin is increasing, while that from vegetal sources is decreasing.

In Arab countries, the per capita protein supply derived from vegetal origin amounted to 73% of the total protein supply, relative to 27% from animal sources[18] . The average share of animal protein among the total supply of protein in GCC countries is higher than the average for Arab countries[18] . Proteins from animal sources are considered of high quality in the human diet because they contain the most complete range of essential amino acids; no single vegetable source provides all essential amino acids. Diets limited in animal source proteins need to contain a mixture of vegetable foods, such as cereals, in combination with pulses or nuts, to meet essential amino acid requirements[9] .

FAO expert consultation regarding carbohydrates revealed the following: 55 percent of total energy should come from a variety of carbohydrates; the majority of carbohydrate foods consumed should be rich in non-starch polysaccharides with a low glycemic index; and a variety of appropriately processed cereals, vegetables, legumes and fruits should be eaten[19].

The contribution of protein to the total dietary energy consumption in the countries of Eastern Mediterranean Region (EMR) ranged from 9% in Djibouti to 13% in Sudan and the UAE. This is close to results from several food consumption surveys in the region. For example, Esmaillzadeh and Azadbakht[22] found that protein in an Iranian diet provided 13-14% of the total daily energy intake. For high quality proteins, the requirements for most people can be met by providing 8-10% of total energy as protein. For predominantly vegetable-based, mixed diets, which are common in a developing country setting, 10-12% is suggested to account for lower digestibility and increased incidence of diarrheal diseases. In the case of elderly people, where energy intake is low, protein should represent 12-14% of total energy consumed[23].

The major food groups that contribute to the protein supply (g/c/d) in GCC countries are cereals, meat, milk and pulses. These four groups constituted more than three-quarters of the total protein supply during the period from 1960-2013. The results showed that in the KSA, cereals contributed more than two-thirds (68.8%) of the protein supply (g/c/d) during the 1960s and a drastic downward percentage share is reported, as the share was only approximately two-fifths (41.8%) of that value in the 2011-13 period. However, the contribution of meat to the protein supply showed a reverse trend, at only 7% in the 1960s but reaching one-quarter of the total protein supply in the 2011-2013 period. In Kuwait, cereals and meats contributed 39 and 20% of the total protein supply during the 1960s and 33 and 29% from 2011-2013, respectively (Table 5).

These findings indicate that consumption patterns in the KSA and Kuwait during the last five decades were directed more towards animal protein rather than plant sources. In the UAE, the percentage share of the contribution of meat to the protein supply decreased from 26% in the 1960s to only 20% in the 2011-2013 period.

Fat supply: In general, adults should obtain at least 15% of their energy intake from dietary fats and oils. Women of childbearing age should obtain at least 20% to better ensure an adequate intake of essential fatty acids needed for fetal and infant brain development. Active individuals who are not obese may consume up to 35% fat energy, as long as saturated fatty acids do not exceed 10% of the energy intake.

Table 5: Percentage shares of the selected food items in the protein supply (g capita^{-1} day^{-1})

Food Items		1961 -1970	1971 -1980	1981 -1990	1991 -2000	2001 -2010	2011 -2013
Cereals	KSA	68.8	52.2	44.6	50.5	45.1	41.8
	Kuwait	38.7	33.5	30.3	30.0	34.2	33.4
	UAE	40.2	32.7	24.8	26.8	32.8	33.4
Pulses	KSA	3.1	2.9	2.8	2.6	2.9	4.0
	Kuwait	4.9	4.5	3.9	4.6	4.1	3.5
	UAE	0.3	4.3	5.1	7.6	9.5	15.3
Sugar and sweeteners	KSA	0.0	0.0	0.0	0.0	0.0	0.0
	Kuwait	0.0	0.0	0.0	0.0	0.0	0.0
	UAE	0.0	0.0	0.0	0.0	0.0	0.0
Vegetables	KSA	2.5	4.1	4.9	4.6	3.2	3.3
	Kuwait	5.8	5.2	6.0	5.7	5.0	5.0
	UAE	1.2	4.6	7.2	7.0	4.3	2.6
Fruits	KSA	3.7	4.5	3.3	3.0	2.7	2.4
	Kuwait	1.8	1.8	1.7	1.5	1.0	1.4
	UAE	1.1	2.2	2.5	2.1	1.7	1.5
Milk	KSA	7.2	12.0	13.7	9.6	8.8	11.8
	Kuwait	15.4	18.7	18.3	17.4	12.1	12.6
	UAE	15.2	16.4	15.9	13.4	11.3	10.5
Meat	KSA	7.4	14.9	20.3	20.6	20.7	24.1
	Kuwait	19.8	21.7	24.5	25.3	30.0	28.5
	UAE	26.3	25.0	28.2	26.4	24.6	19.5
Animal fat	KSA	0.0	0.0	0.0	0.0	0.0	0.2
	Kuwait	0.1	0.1	0.1	0.1	0.2	0.1
	UAE	0.7	0.2	0.1	0.1	0.1	0.1

Sedentary individuals should limit fat to not more than 30% of their energy intake. Saturated fatty acids should be limited to less than 10% of the energy intake[23,24]. Data from various nutrition surveys in the region have shown that the intake of saturated fat is very high, even in countries with a relatively low daily supply of fat[25].

Fat supply trends in Kuwait and the KSA constantly increased during 1961-2013 (from 31 and 73 g capita^{-1} day^{-1} to 85 and 113 g capita^{-1} day^{-1}, respectively); however, in the UAE, the fat supply trends increased in the first three decades (1961-1990) from 86-121 g capita^{-1} day^{-1}, while in the last two decades, the fat supply has decreased from 106-89 g capita^{-1} day^{-1} (Fig. 4).

During the period from 1961-2013, the annual growth rate of the fat supply from animal sources was highest in the KSA (2.5%), followed by Kuwait (0.7%), while a downward annual growth rate was reported in the UAE (-1.9%) (Table 2).

Table 6 shows the percentage share of the different food items in the fat supply in GCC countries during the study period (1961-2013). The major food items that contributed to the fat supply in GCC countries are vegetable oils, meat, milk, cereals and animal fat. These food items contributed more than 80% of the total fat supply in the KSA, Kuwait and the UAE throughout the last five decades. However, the percentage share of the different food items in the fat supply of GCC countries reveals greater disparity. For instance, vegetable oils in the KSA contributed approximately one-third of the total fat supply during the 1960s and this number

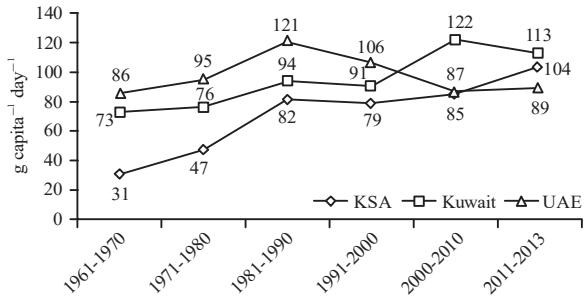

Fig. 4: Fat supply trend (g capita^{-1} day^{-1}) in selected GCC countries, 1961-2013

increased to half of the fat supply in 2011-2013. In the UAE, the vegetable oil percent contribution increased from 0.4% in the 1960s to 31% in 2011-2013, while in Kuwait, it ranged from 41-45% during the same period.

In the KSA, meat contributed almost 15% of the total fat supply during the last five decades. In Kuwait, meat accounted for 26% of the total fat supply in the 1960s and then decreased to only 22% in 2011-2013, while in the UAE, meat accounted for 25 and 17% of the total fat supply in the 1960s and in 2011-2013, respectively. In the UAE, animal fat made noteworthy contributions (51%) to the per capita supply of fat in the 1960s; however, it was only one-tenth of that contribution in 2011-2013. In the KSA, cereal fat decreased from 26.7 to -8% of the total fat supply from 1961-2013.

In the 1960s, the milk contribution to the total fat supply was 10, 8.6 and 14.6% in the KSA, Kuwait and the UAE,

Table 6: Percentage shares of the selected food items in the fat supply (g capita^{-1} day^{-1}) 1961-2013

Food Items		1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2013
Cereals	KSA	26.70	15.00	10.50	12.00	11.00	8.20
	Kuwait	5.80	5.00	3.80	4.20	4.00	0.00
	UAE	4.60	5.40	3.70	3.70	4.70	5.70
	KSA	0.00	0.00	0.00	0.00	0.00	0.00
Sugar and sweeteners	Kuwait	0.00	0.00	0.00	0.00	0.00	0.00
	UAE	0.00	0.00	0.00	0.00	0.00	0.00
	KSA	0.80	1.00	0.90	0.80	0.60	0.50
Vegetables	Kuwait	1.20	1.00	1.10	1.20	0.90	0.90
	UAE	0.20	0.90	1.20	1.30	1.10	0.60
	KSA	1.70	1.70	1.10	1.00	0.90	0.80
Fruits	Kuwait	0.80	0.80	0.70	0.60	0.30	0.60
	UAE	0.30	0.70	0.70	0.80	0.90	0.80
	KSA	10.20	10.60	8.10	8.90	8.20	8.10
Milk	Kuwait	8.60	10.70	9.20	11.00	9.40	9.20
	UAE	14.60	17.30	15.70	14.80	12.80	10.50
	KSA	14.20	17.70	17.60	16.80	16.90	15.90
Meat	Kuwait	26.00	26.30	25.30	25.10	22.50	21.70
	UAE	25.20	26.50	28.60	26.60	24.20	16.80
	KSA	7.10	8.70	6.60	4.90	4.80	6.60
Animal fat	Kuwait	5.10	6.70	7.80	5.90	5.90	4.80
	UAE	51.00	22.00	8.30	7.90	7.60	5.00
	KSA	29.20	34.70	46.40	48.30	49.00	49.50
Vegetable oil	Kuwait	41.00	33.20	37.00	36.90	42.60	45.90
	UAE	0.40	16.10	26.60	27.30	28.00	31.40
Pulses	KSA	0.50	0.40	0.30	0.30	0.40	0.40
	Kuwait	0.50	0.50	0.40	0.50	3.50	3.20
	UAE	0.01	0.37	0.42	0.90	1.25	2.07

Table 7: Share of macronutrients in the DES (kcal capita^{-1} day^{-1}) in GCC countries

		1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2013
Protein	KSA	10	11	11	11	12	11
	Kuwait	12	12	12	12	12	12
	UAE	11	12	13	13	13	13
Fat	KSA	15	20	26	25	25	29
	Kuwait	26	25	29	29	31	30
	UAE	28	28	32	29	24	25
Carbohydrates	KSA	75	69	63	65	63	60
	Kuwait	63	63	59	59	56	58
	UAE	61	60	55	58	63	63

respectively. In 2011-2013, milk accounted for 8% in the KSA, 9% in Kuwait and 10.5% in the UAE of the total per capita fat supply.

Contribution of macronutrients to the dietary energy supply (DES): The contribution of macronutrients to the dietary energy supply (DES) refers to the share of energy supplied from macronutrients (protein/carbohydrates/fats) to the DES[26] .

In general, carbohydrates and fats are completely oxidized in the body. In contrast, protein is only partially oxidized, resulting in the excretion of urea and other nitrogenous products. Oxidation of one gm of dietary carbohydrate and one gm of dietary protein (which is oxidized to urea) each yield approximately 4 kcal, whereas oxidation of one gm of dietary fat yields approximately 9 kcal[27].

The percentage contribution of macronutrients (carbohydrates, protein and fat) to the total DES was estimated. The results revealed that in the KSA, during the 1960s, carbohydrates contributed three-quarters (75%) of the total DES but only three-fifths of the total DES (60%) in 2011-2013. Additionally, in Kuwait, the carbohydrate contribution to the DES showed a decreasing trend as the contribution dropped from approximately two-thirds (63%) in the 1960s to only 58% in 2011-2013. In the UAE, there was a slight increase in the DES contribution from carbohydrates, as shown in Table 7.

This decline in the DES contribution from carbohydrates in the KSA and Kuwait was accompanied by an increase in the percentage share of energy from fat. In the KSA, the contribution of fat to the DES in 2011-2013 was almost double

that during the 1960s. The protein contribution to the DES showed slight differences ranging between 10 and 13% during the past five decades in the three countries.

Table 8 shows the analysis of variance with multiple mean comparison (LSD) for different parameters in the three GCC countries. These parameters include total food, protein and fat supplies (G/c/d); macronutrients contributions to the dietary energy supply (DES) (kcal capita^{-1} day^{-1}), animal and vegetal contributions to the DES (kcal capita^{-1} day^{-1}), protein and fat supplies (g capita^{-1} day^{-1}), contribution of the

Table 8: Food supply, macronutrient contribution to the DES and the share of the selected food groups in the DES, protein and fat supplies

		Mean differences (LSD) and significance		
	F-value	KSA-Kuwait	KSA-UAE	Kuwait-UAE
Grand total of FS (G/C/D)	(27)*	-363*	-581*	-218*
Grand total protein supply (g/c/d)	(60)*	-18*	-29*	-10*
Grand total fat (g/c/d)	(35)*	-25*	-31*	-6
Macronutrient contribution to the dietary energy supply (DES) (kcal capita^{-1} day^{-1})				
Carbohydrates	(10)*	-63	-180*	-117*
Protein	(60)*	-74.*	-117*	-43*
Fat	(36)*	-226*	-283*	-57
Animal and vegetal contribution to the DES (kcal capita^{-1} day^{-1}), protein and fat supplies (g capita^{-1} day^{-1})				
Animal products				
DES (kcal capita^{-1} day^{-1})	(164)*	-282*	-471*	-189*
Protein (g capita^{-1} day^{-1})	(118)*	-20*	-25*	-5*
Fat (g capita^{-1} day^{-1})	(142)*	-19*	-38*	-19*
Vegetal				
DES (kcal capita^{-1} day^{-1})	1.17	-80	-97	-17
Protein (g capita^{-1} day^{-1})	(5)*	1	-3*	-4*
Fat (g capita^{-1} day^{-1})	(9)*	-7*	7*	13*
Vegetables				
Food supply (kg person^{-1} day^{-1})	(18)*	-62.*	-60*	0.86
DES (kcal capita^{-1} day^{-1})	(19)*	-38*	-41*	-2.9
Protein (g capita^{-1} day^{-1})	(26)*	-2*	-2*	-0.1
Fat (g capita^{-1} day^{-1})	(31)*	-0.4*	-0.4*	0.02
Fruits				
Food supply (kg person^{-1} day^{-1})	(7)*	7	-17*	-24*
DES (kcal capita^{-1} day^{-1})	(66)*	103*	38*	-65*
Protein (g capita^{-1} day^{-1})	(45)*	0.96*	0.36*	-0.6*
Fat (g capita^{-1} day^{-1})	(12)*	0.19*	0.09*	-0.1*
Milk				
Food Supply (kg person^{-1} day^{-1})	(121)*	-77*	-74*	2.7
DES (kcal capita^{-1} day^{-1})	(114)*	-88*	-134*	-45*
Protein (g capita^{-1} day^{-1})	(102)*	-7*	-7 *	-0.02
Fat (g capita day^{-1})	(137)*	-3*	-9*	-6*
Meat				
Food Supply (kg person^{-1} day^{-1})	(61)*	-27*	-36*	-10*
DES (kcal capita^{-1} day^{-1})	(101)*	-142*	-183*	-41*
Protein (g capita^{-1} day^{-1})	(62)*	-9*	-13*	-4*
Fat (g capita^{-1} day^{-1})	(116)*	-11*	-14*	-3*
Animal fat				
Food supply (kg person^{-1} day^{-1})	(31)*	-1	-6*	-5*
DES (kcal capita^{-1} day^{-1})	(32)*	-14	-117*	-102*
Protein (g capita^{-1} day^{-1})	(32)*	-0.07*	-0.19*	-0.12*
Fat (g capita^{-1} day^{-1})	(32)*	-1.6	-13*	-11*
Vegetable oil				
Food supply (kg person^{-1} day^{-1})	(18)*	-2*	3*	6*
DES (kcal capita^{-1} day^{-1})	(18)*	-54*	81*	136*
Protein (g capita^{-1} day^{-1})	(13.5)*	-54*	81*	136*
Fat (g capita^{-1} day^{-1})	(18)*	-6*	9*	15*
Pulses				
Food supply (kg person^{-1} day^{-1})	20*	-4. *	-6*	-2*
DES (kcal capita^{-1} day^{-1})	30*	-13	-58*	-44*
Protein (g capita^{-1} day^{-1})	33*	-2*	-4*	-2*
Fat (g capita^{-1} day^{-1})	15*	-1*	-0.4*	0.68*

*indicates significance at the 5% level or less

major food items (vegetables, fruits, milks, meats, animal fats, vegetable oils and pulses) to the DES (kcal capita^{-1} day^{-1}).

The parameters under investigation are illustrated in Table 7. A significant difference was observed for all the parameters under investigation in the three countries, with the exception of the vegetal contribution to the DES (kcal capita^{-1} day^{-1}), these differences were illustrated and discussed in details in the above mentioned Table (1-6).

Many similar geographical; economic; political and social features characterize GCC countries. Moreover, these countries mainly depend on food imports to achieve food security. However, this study discovered that the patterns, growth rates and trends of food supply and consumption in GCC countries showed a wide disparity in per capita food supplies in term of quantity (g capita^{-1} day^{-1}), caloric value (kcal capita^{-1} day^{-1}) and protein and fat contents (g capita^{-1} day^{-1}) and contribution of vegetal and animal sources to energy, protein and fat supply.

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