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Review

Changes in the nutrient quality of meat in an obesity context

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ABSTRACT

Today, being either overweight or obese is becoming the norm both in developing and developed countries. Developing countries often experience a double burden of nutrition-related diseases, as both over and undernutrition are experienced, with overweight presently exceeding underweight in most developing countries. Global diet trends such as moving from a traditional diet to more refined foods and increased sugar and saturated fat intake are identified as contributing to excess energy intake. The nutritional content of meat is non-homogenous and dynamic and meat has changed considerably in fat content, in many countries, during the last decade due to consumer demand. Choosing a particular meat cut of a specific fatness level, prior to cooking and consuming it without added high energy condiments, as well as trimming on the plate, can make a significant contribution to decrease energy intake, from a total diet perspective. Prudent portion size is also of importance. Meat is recognised as an important source of protein, vitamin B_{12}, Vitamin D and essential Omega 3 fatty acids, as well as bio-available minerals such as iron, zinc and selenium.

Contents

1. Introduction

Undernutrition and underweight have dominated public health for many decades. Health problems associated with overweight and overnutrition have only emerged during the last 10 years as of global importance and even more recently within a developing country focus. Globally at present, an estimated 1.1 billion adults are overweight, accounting for approximately 26% of the world population (Haslam & James, 2005).

In developing countries, numerous deficiency diseases continue to exist, especially in rural communities, due to essential nutrient deficiencies in the daily diet. Increasingly, this now coexist with the presence of diet-related chronic diseases previously only seen in developed countries. Today, most developing countries face the consequences of both nutritional deficiencies and excesses and are subjected to the double burden of persisting undernutrition in the midst of the growing epidemic of obesity and non-communicable diseases such as cancer and heart disease.

Chronic undernutrition affects some 215 million people in sub-Saharan Africa or 43% of the population. According to the World Health Organisation (WHO, 2008), an estimated 206 million people

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in Africa are iron deficient, 86 million are affected by iodine deficiency and 33 million are deficient in vitamin A (Standing Committee of Nutrition SCN, 2004). In South Africa hunger and malnutrition are found in many of the rural areas, at an estimate of at least three million black people under the age of 15 suffering from clinically diagnosable malnutrition. In 1996, a comprehensive national survey in South Africa was undertaken on the nutritional status of preschool children (SAVACG, 1996) and reported that one in four children was stunted and 1 in 10 was underweight. This was followed by the national Food Consumption Survey that collected baseline data in 1999, showing that nearly one out of five children (21.6%) aged 1–9 years is affected by stunting, which is the most common nutritional disorder in the country. The condition was found to be more prevalent on commercial farms and in tribal and rural areas as compared to urban areas. Stunting decreases with age and the highest prevalence was found among children aged 1–3 years. The study revealed that the majority of South African households live in poverty with a limited variety of foods (mainly staples) available in the home. Findings from this study also indicate that one out of two children had an energy intake less than two-thirds of their energy needs and that a great number of children consume a diet with poor nutrient density in order to meet their nutrient (macro and micro) requirements. Due to inadequate protein, vitamin and mineral intake, malnutrition is widespread in South Africa (Labadarios et al., 2001).

A double burden of nutrition-related diseases is prevalent in many households and communities in South Africa, as both over and undernutrition are experienced due to rapid urbanization and acculturation. Numerous South Africans suffer from the health-implications of inappropriate diets, with obesity the most important nutritional disease, in causing many of the major non-communicable diseases.

According to WHO (2008), non-communicable diseases caused an estimated 35 million deaths in 2005, representing 60% of all deaths globally. Eighty percent of deaths due to non-communicable diseases occur in low and middle-income countries, and approximately 16 million deaths involve people less than 70 years of age. Total deaths from non-communicable diseases are projected to increase by a further 17% over the next 10 years. The rapidly increasing incidence of these diseases is affecting poor and disadvantaged populations disproportionately, contributing to widening health gaps between and within countries. An estimated 24% and increasing all the time of deaths in Sub-Saharan Africa are attributed to non-communicable diseases.

The obesity epidemic is recognised globally with the numbers increasing daily. In South Africa in 2003, 56.2% of the adult population was recorded overweight or obese (Demographic & Health Survey, 2003). In 2005, 87.4% of the adult American population were reported as either overweight or obese (Centre for Disease Control and Prevention (CDC, 2006). Being either overweight or obese is becoming the norm both in developing and developed countries (Ammerman, Leung, & Cavallo, 2006).

It is well known that lifestyle and nutrition choices of individuals influence the occurrence of obesity. Individuals are increasingly becoming more aware of the fact that eating a healthy nutrient dense, energy controlled, diet and partaking in more physical activity to increase energy expenditure, will decrease the chance of becoming overweight. Individuals base their food choices and other decisions regarding nutrition on the knowledge they have gained throughout their life (De Boer, Hoogland, & Boersema, 2007).

Although science is in its nature innovative, and information is updated with time, most individuals continue to base their decisions on information they have learned in the past. This may be both due to the lack of communication of new data, misinterpretation thereof, or with the great amount of unscientific information available on the internet and other public sources, confusion and skepticism on what to believe (Patterson, Satia, Kristal, Neuhouser, & Drewnowski, 2001; Van Dillen, Hiddink, Koelen, De Graaf, & Van Woerkum, 2003).

Red meat includes beef, veal, pork and lamb (Linseisen et al., 2002) and according to various dietary guidelines and nutrition text books, red meat is a primary dietary component and forms an important part of a balanced and varied diet (Whitney & Rolfes, 2008; USDA Dietary Guidelines, 2000). Today there is ample new research that provides evidence that red meat can be consumed daily. However, based on epidemiological studies, obesity and high saturated fat intake from animal products has a positive association (Biesalski, 2005; Chao et al., 2005). This has led to a concern that total dietary fat intake should be restricted by consuming smaller portions less frequently.

However, meat plays an integral role in global eating (Grunert, 2006) and the nutritional attributes of meat, which provide a major proportion of consumer requirements for protein, some vitamins and certain minerals, are highlighted in work on the nutritional value of meat (Breidenstein, 1987; Johnson, 1987; Robinson, 2001). These studies also reflect the substantial changes over time in the composition of carcass meat, especially reduction in the amount of fat both on the carcass itself and after trimming in the shop or at home, as well as in the effect of changes in cooking methods (Chan, Brown, Lee, & Buss, 1995; Higgs, 2000). The percentage fat present in New Zealand beef carcasses have for instance decreased from 23.3% in 1981 to 7.1% in 1997 (EuroFIR, 2008). In South Africa, similar results have been found with the average fat content of target grade beef decreasing from 32% in 1949 to 18% in 1981 to 13% in 1991 and still continuing (Naudé, 1994). These changes in the fat content can be assigned to the increase in consumer demand for leaner red meat products.

The challenge lies in the communication of the information to the consumer and health professionals who advise consumers. Food composition database tables are important in this regard to monitor and explore the changes in food composition in order to be able to communicate these changes to the public (Greenfield & Southgate, 2003).

2. The obesity epidemic – the current situation and perceptions

2.1. Developing countries

Many developing countries, such as South Africa, face the double burden of disease, with both overweight and underweight groups. The National Food Consumption Survey (NFCS) of 1999 reported that dietary intake of two-thirds of South African children were below the RDAs for energy and various micronutrients, including iron, zinc, vitamin A, riboflavin, niacin and vitamin B_6 (Labadarios et al., 2001). Contrasting this finding, the South African Department of Health's 2003 Demographic and Health Survey (DHS) reported a total of 21.1% of South African men over the age of 15 years are overweight, while 8.7% are obese. For women over the age of 15 years, the corresponding numbers are 29% overweight and 23% obese, indicating that over 40% of South African adults are either overweight or obese (DHS, 2003). In estimating the burden of disease attributable to excess body weight in South Africa, the authors conclude that excess body weight is likely to continue contributing to ill health in both poor and wealthier sectors of the population (Joubert et al., 2007).

Although the South African overweight rates are lower than those in developed countries such as the United States of America, it is still alarming. Especially when seen against the backdrop of high HIV/AIDS prevalence rates and poor public health infrastructures. According to the World Health Organization (WHO) the main cause for deaths in South Africa is chronic disease (53.9%).

Of these, cardiovascular disease (51%) is the major cause, followed by cancer (20%) (WHO, 2001). With the association of non-communicable diseases such as cardiovascular disease and cancer with weight gain and obesity, it becomes critical to reverse the current trend in obesity and overweight prevalence rates. Both undernutrition and overnutrition need to be combated and this can be done through sustainable and effective public health intervention programs. These should include: scientifically based research, communication of research results, policies, awareness programs and feeding schemes (CDC, 2006).

2.2. Developed countries

In 2005, 60.5% of adult Americans were recorded as overweight, 23.9% as obese and 3% as extremely obese (CDC, 2006). Alarmingly, childhood obesity rates have increased three to fourfold over the past 25 years in the United Kingdom (Musgrave, 2007). The link between obese children turning into obese adults are established, as is the higher risk of developing obesity-related morbidities, such as cardiovascular disease and type 2 diabetes in later life. Of great concern is the fact that an International Food Information Council (IFIC) health survey (2006) found that approximately 75% of Americans thought that they were in "excellent" or "good" health, indicating that their perception of health is totally out of line with the reality of their health. Once again the importance of education and information is highlighted.

3. The role of food composition data and consumer education

Scientific research and the communication of the findings are of extreme importance in consumer education. Around the world, the lifestyle and nutrition choices that individuals make influence the obesity rates. Individuals base their decisions regarding nutrition on the knowledge they have gained throughout their life. Without proper and reliable communication of new information, e.g., new food composition data and results from epidemiological studies, consumers tend to continue basing their food and health choices on past knowledge. It is therefore important to ensure that consumers are informed of updated and new information to enable them to make the best lifestyle choices. In this context, the nutritional analysis of current food commodities, such as red meats, and the updating of food composition tables are not only important to monitor the changes in food composition over time, but also to enable communication of these changes to the public (Greenfield & Southgate, 2003).

The nutritional composition of South African lamb is an example of changes in food composition reported in national food composition databases. The Heart Foundation (www.heartfoundation.com) as well as the Cancer Foundation (www.cancer.org) states that the fat content of food products consumed should be less than 10%. According to the 1999 edition of the Composition of South African Foods, the fat content for lamb was listed as 21.6% (Sayed, Frans, & Schönfeldt, 1999). These values reported in the 1999 edition were not South African but derived from the United States Department of Agriculture (USDA) Food Composition Database (1986), which has since also been updated and is continued to be so (USDA, 2007). Recently, South African lamb with a fatness level of 2, which is the most frequently consumed class of sheep meat consumed in South Africa, was analysed. Results showed that South African lamb contains, on average, only 9.01% fat. These values differ significantly to those previously available to consumers and health professionals. The implication of these findings are that a product that was previously thought to be "unhealthy" based on its fat content, in fact lies within the recommended fat percentage range.

Table 1
Fatty acid composition of sa mutton, lamb and beef

Fatty acids	South African mutton (ARC, 2008)	South African lamb (Van Heerden, 2007)	South African beef (Schönfeldt & Welgemoed, 1996)
Cholesterol-raising fatty acids			
(Total calculated)	2.37	2.42	3.64
C14:0 myristic acid	0.22	0.46	0.37
C16:0 palmitic acid	2.15	1.96	3.27
Cholesterol-neutral fatty acids			
C18:0 stearic acid	1.91	1.16	2.99
Cholesterol-lowering fatty acids			
(Total calculated)	3.63	3.22	5.40
C18:1 oleic acid	3.40	2.97	5.12
C18:2 linoleic acid	0.22	0.25	0.24
C20:4 arachidonic acid	0.01		0.04
Effect unknown			
C16:1 palmitoleic acid	0.13	0.18	0.40

As reported by Pollard, Kirk, & Cade (2002) health factors are one of the main drivers in food choice and consumption. More and more consumers are aware of the health benefits of diet and nutrition and are willing to make lifestyle changes to reduce the risk associated with an unhealthy lifestyle (Peng, 2004). This stretches the importance of education not only about the nutritional composition of the foods they consume, but also about the individual nutrient's impact and influence on health.

An example is consumers' general association of fat and all its constituents, e.g., fatty acids, as being detrimental to their health. According to IFIC (2006), the majority of consumers (91%) have heard about saturated fatty acids and its detrimental effect on health, while only 36% have heard about the essential fatty acids, e.g., omega 6 fatty acids, and less than 25% have heard about the cholesterol-lowering fatty acids, namely DHA (docosahexaenoic acid), EPA (eicosapentaenoic acid), CLA (conjugated linoleic acid) or ALA (α-linolenic acid).

Fat present in food products are not just associated with weight gain, but also with elevated cholesterol levels. But, as shown in Table 1, not all fatty acids are responsible for elevated cholesterol levels. In fact for the different red meat reported in the table, all contained on average more cholesterol lowering fatty acids than cholesterol raising fatty acids. The IFIC (2006) survey found that almost 40% of respondents that were aware of mono and polyunsaturated fatty acids, considered them as being unhealthy, despite dietary guidelines to increase the consumption of these specific fatty acids. According to Wood et al. (1999), the fat content and in particular the presence of essential fatty acids in meat products not only play an important role in the nutritional value of meat, but influences various aspects of meat quality. This again emphasizes consumer education as a key role player in making informed dietary choices.

4. Meat consumption patterns

Worldwide, there is a growing demand for high-value animal protein today. The global increase in per capita consumption of red meat is evident from Bruinsma (2003) which reported an increase from 24.2 kg/year in 1964 to 36.4 kg/year in 1999. The expected per capita consumption of animal produce according to Bruinsma (2003) and EuroFIR (2008) should increase to 45.3% by 2030.

However, Williamson, Foster, Stanner, & Buttriss (2005), along with various other authors, reported that meat consumption in developed countries have decreased (Fowler, 2004; Red Meat & Health Expert Advisory Committee, 2001).

Although meat is a favourite and popular food in the diet of South Africans (Scholtz, Vorster, Matsego, & Vorster, 2001), the popularity of red meat in South Africa and abroad is consistently declining in favour of white meat as well as other non-meat proteins. The South African Department of Agriculture has reported a slight increase in per capita red meat consumption from 18.91 kg in 2000/1 to 24.6 kg in 2005/6 (Abstract of Agricultural Statistics, 2008). This may be due to urbanization and changes in consumption patterns as consumers migrate from rural settings to urban settlements and subsequently increased consumption in certain food products such as red meat with an increase in household income (Greenhalgh, Morgan, Edwards, & McDonald, 2002; Valin, 2000). However, over a longer period of time, the per capita consumption of red meat in South Africa declined from 43.72 kg in 1970/1 to 21.91 kg in 1995/6 to 18.91 kg in 2000/1, compared to poultry meat that increased over the same period from 6.2 to 17.6 to 20.3 kg (Abstract of Agricultural Statistics, 2008). Although the price difference between white and red meat is recognised as contributing to this phenomenon, another important reason is the perceived health risk associated with the consumption of products considered to be high in total and saturated fat.

5. Changes in nutrient composition of meat

Meat is a valuable food source rich in many of the essential nutrients including protein, iron, zinc, selenium, vitamin B_{12}, Vitamin D and essential Omega 3 fatty acids. Although red meat is generally classified as a high protein, iron and fat source, the nutritional compositions of foods, like meat, are non-homogenous and ever changing. EuroFIR (2008) reported on the significant changes in the iron and fat content of meat in developed countries over time. These changes are as a result of various factors including soil and forage composition, environmental factors and post-slaughtering activities such as trimming and cooking methods.

With one in four South Africans affected by coronary heart disease (Meat & healthy eating, 2003), concerns have been raised concerning the link between high saturated animal fat intake and cardiovascular disease as well as certain types of cancers (Radder & Le Roux, 2005). Health factors are one of the main drivers in consumption (Pollard et al., 2002), and in order to comply with the South African consumers' preferences for leaner meat (Shongwe, Jooste, Hugo, Alemu, & Pelser, 2007) the fat level of the target grade (Super A) beef carcasses has changed considerably from 32% to 13% (Naudé, 1994).

Consumers should be educated to make an informed choice in selecting and preparing red meat, prior to consumption. Differences in nutritional composition of South African red meat can be seen in Tables 2–4. Schönfeldt (1998) reported significant differences in nutritional composition between beef carcasses of different age groups (Table 2), but reported even more significant differences within a specific age group, between different fat classes (Table 3). However, there is a larger difference in the fat content of different cuts within the same carcass than between beef carcasses of different age groups and fatness levels. For instance, a cooked fillet of an A age animal with a fatness level of 2 contains on average 8% fat, compared to 34% fat in the thin flank of the same carcass (Table 4).

New data on South African lamb shows (Table 2) that it contains on average 42% less fat and 59% less energy (Van Heerden, 2007), when compared to data that were previously reported in the Food

Table 2
The nutritional composition of South African red meat as depicted by various age classes and grades

Attribute	South African beef (carcass values derived from all cuts) (Schönfeldt, 1998)						South African lamb (Van Heerden, 2007)		South African veal (De Bruin, 1994)			
	Raw			Cooked			Raw	Cooked	Raw		Cooked	
Proximate	A-age	B-age	C-age	A-age	B-age	C-age	A2	A2	Grade 1	Super	Grade 1	Super
Fat	19.79	19.90	20.07	24.07	21.14	19.63	9.01	8.44	5.90	15.74	9.84	20.81
Protein	18.16	18.65	18.44	26.16	26.27	27.29	18.3	25.1	21.37	19.32	27.38	22.56
Moisture	61.13	60.95	60.65	51.27	51.15	50.30	71.5	65.4				
Fatty acids												
14:0	0.43	0.38	0.41	0.47	0.37	0.43	0.57	0.50	0.42	0.71	0.50	0.95
16:0	3.58	3.58	3.93	3.91	3.94	4.24	2.22	1.99	2.28	3.39	3.10	3.80
16:1	0.63	0.60	0.55	0.46	0.44	0.50	0.19	0.19	0.44	0.70	0.63	0.90
18:0	2.95	2.89	2.89	3.13	3.19	3.00	1.46	1.07	1.18	1.61	1.56	1.98
18:1	6.00	6.38	6.48	6.57	6.76	6.74	3.43	2.86	2.92	5.63	3.64	6.55
18:2	0.55	0.34	0.20	0.45	0.27	0.17	0.27	0.24	0.43	0.36	0.33	0.53
20:4	0.03	0.03	0.02	0.03	0.03	0.03			0.06	0.04	0.08	0.05
Cholesterol	70.97	68.07	61.18	88.06	89.10	82.42	62.8	87.7	84.27	86.50	117.68	92.90
Vitamins												
Thiamin	0.116	0.110	0.100	0.135	0.105	0.094	0.10	0.04	0.133	0.079	0.124	0.087
Riboflavin	0.104	0.115	0.112	0.122	0.105	0.122	0.09	0.05	0.110	0.092	0.191	0.151
Nicotinamide	4.62	4.33	4.05	4.10	4.09	4.20	1.47	1.42	5.52	4.91	8.37	5.11
Pyridoxine	0.252	0.295	0.387	0.382	0.373	0.383	0.40	0.12	0.401	0.209	0.233	0.217
Folic acid	9.02	10.89	15.03	12.85	14.01	14.20			6.06	10.85	9.81	9.87
Cyanocobalamin	1.34	1.58	1.77	1.97	2.10	2.13	3.54	0.93	1.81	1.89	2.06	1.82
Biotin	1.99	1.95	2.55	1.95	2.06	2.03			1.79	2.03	3.00	2.28
Pantothenic acid	0.322	0.288	0.265	0.258	0.255	0.252			0.358	0.447	0.411	0.232
Minerals												
Phosphorus	160	167	158	165	181	165			200	164	218	178
Calcium	13.7	14.8	14.3	12.3	15.1	14.5			18.2	27.8	23.3	27.9
Magnesium	18.2	19.0	20.0	23.0	22.6	22.9	20.1	21.7	22.7	13.9	25.0	25.8
Potassium	272	293	278	260	280	277	291	298	323	292	348	293
Sodium	88	100	95	79	95	93	83.4	71.3	91	77	89	89
Copper	0.229	0.165	0.141	0.121	0.164	0.145			0.180	0.521	0.410	0.923
Zinc	3.28	3.59	3.53	4.42	5.03	4.90	2.25	1.72	1.54	1.54	3.80	2.14
Manganese	0.014	0.017	0.012	0.018	0.057	0.023			0.033	0.041	0.021	0.053
Iron	0.94	1.08	1.94	1.96	2.54	2.76	0.96	0.63	0.55	0.68	0.75	0.94

Table 3
The nutritional composition of different carcass fatness levels of a age south african beef (as adopted from Schönfeldt, 1998)

Carcass fatness percentage	Raw					Cooked				
	11,45	15,41	20,13	21,29	25,16	11,45	15,41	20,13	21,29	25,16
Proximate										
Water (g)	65.42	61.78	58.82	56.97	53.47	54.63	52.94	50.03	45.78	43.68
Protein (g)	19.22	18.62	16.52	17.21	16.80	27.73	25.48	25.70	24.26	23.20
Fat (g)	14.21	18.33	23.88	24.95	29.50	15.93	20.13	23.39	28.81	32.09
Energy (kJ)	880	1024	1196	1249	1414	1097	1215	1342	1521	1625
Minerals										
Phosphorus (mg)	164	162	159	153	140	180	171	155	156	140
Calcium (mg)	13.1	8.3	17.9	16.8	15.8	13.3	10.6	12.0	14.6	11.1
Magnesium (mg)	18.8	19.2	18.4	16.2	15.5	24.1	23.8	22.0	22.2	20.6
Potassium (mg)	274	270	275	256	250	282	273	260	230	220
Sodium (mg)	85	108	87	82	79	80	84	80	81	70
Copper (mg)	0.324	0.309	0.111	0.193	0.115	0.101	0.129	0.149	0.170	0.101
Zinc (mg)	3.42	3.22	3.39	3.08	2.88	5.24	4.45	4.23	3.36	4.08
Manganese (mg)	0.017	0.015	0.006	0.012	0.013	0.011	0.022	0.022	0.016	0.016
Iron (mg)	0.67	1.05	1.59	0.71	0.70	2.35	1.99	1.77	1.51	2.19
Vitamins										
Thiamin (mg)	0.133	0.136	0.103	0.090	0.093	0.223	0.107	0.107	0.102	0.106
Riboflavin (mg)	0.080	0.120	0.116	0.105	0.091	0.200	0.110	0.091	0.110	0.104
Nicotinamide (mg)	5.36	4.99	3.84	3.57	3.97	4.48	4.43	3.70	3.86	4.05
Pyridoxine (mg)	0.212	0.218	0.434	0.194	0.212	0.395	0.372	0.386	0.345	0.405
Folic acid (mg)	10.22	7.91	12.49	7.38	7.12	12.90	12.07	13.40	12.31	13.59
Cyanocobalamin (mg)	1.04	1.41	1.63	1.37	1.27	2.13	2.26	1.83	1.60	2.01
Biotin (mg)	1.47	1.96	2.66	2.04	1.80	2.28	1.79	1.75	1.86	2.07
Pantothenic acid (mg)	0.306	0.392	0.260	0.289	0.313	0.253	0.278	0.228	0.277	0.249
Fatty acids										
14:0 (g)	0.29	0.41	0.53	0.55	0.65	0.37	0.39	0.46	0.62	0.74
16:0 (g)	2.93	3.68	4.08	4.22	4.29	3.27	3.86	4.21	4.60	5.20
16:1 (g)	0.60	0.46	0.49	0.77	1.22	0.40	0.36	0.43	0.64	0.77
18:0 (g)	2.66	2.88	3.36	3.54	2.55	2.99	3.08	3.18	3.82	3.02
18:1 (g)	4.67	5.78	6.97	6.81	9.43	5.12	6.29	7.04	8.11	9.82
18:2 (g)	0.46	0.34	0.70	0.73	0.68	0.24	0.39	0.59	0.65	0.48
20:4 (g)	0.03	0.01	0.03	0.04	0.03	0.04	0.02	0.02	0.04	0.03
Cholesterol (mg)	75.53	69.46	57.50	77.08	77.07	87.52	96.16	89.58	77.32	83.03

Composition Tables of the South African Medical Research Council (MRC) (Sayed et al., 1999). Van Heerden, Schönfeldt, Kruger, & Smith (2007) reported that on average, South African lamb contains less than 10% fat.

The differences in the nutritional composition of South African red meat have not only been found between whole carcasses from different age groups and fat classes, but significant differences have been found between different cuts in a carcass within the same age group and fat class (Table 4). During the study on South African lamb (Van Heerden, 2007) the compositions of three commercial cuts namely shoulder, loin, and leg were determined and the loin cut had the lowest percentage fat, and represents the highest difference in fat from the previously reported MRC values (Sayed et al., 1999). These results signify the value of selecting lean carcass cuts when making low fat purchasing decisions.

As mentioned previously, meat is an excellent source of protein that contains all the essential amino acids. It is furthermore a good source of a variety of vitamins and minerals, like iron, zinc and the B-vitamins. It is important to note that in leaner meat, the nutrient content is higher, as fat dilutes the nutrients in the protein matrix (Delport & Schönfeldt, 2007). This further emphasize the importance of accurate up-to-date nutrient content values as a change in one nutrient can have an impact on the values of other nutrients. With the prevalence of nutritional deficiencies in South Africa, this higher percentage in nutrient composition of lean red meat, especially in protein, iron and the B vitamins, increases the positive health image associated with the consumption of lean red meat.

From these studies, it can be concluded that red meat is a non-homogenous food commodity, and is ever changing over time. It becomes evident that in context of obesity it is possible for the South African consumer to gain optimal nutritional benefits and abstain from excessive kJ and saturated fat intake when consuming red meat on a regular basis. This can be done by considering the fat class of the animal, as well as the specific carcass cut when purchasing red meat, and ensuring low fat cooking and preparation methods.

6. The way forward

Promoting healthy lifestyles to reduce the global burden of non-cummunicable disease requires a wide multisectoral approach. This approach needs to involve various sectors in societies and promotion of lifestyle changes such as controlled dietary intake and increased physical activity. The availability of current and correct, scientifically based, nutritional information which the consumer can relate to, plays a major role in promoting healthy lifestyle choices.

6.1. Changing diet and lifestyle

Dietary patterns and other lifestyle habits influence an individual's weight. If significant changes can be made to an individuals diet, through the choices they make as well as the nutrient content of the food consumed, the obesity rate can be reduced. There are, however, various barriers to changing the consumer's diet and lifestyle. These include consumer's lack of understanding of nutrition information such as basic kJ content of products and the amounts (portion size) they can and should consume per day. Many consumers are unaware of their weight status and the impact thereof on their general health. The question arises, do they really care?

Table 4
The nutritional composition of different South African red meat carcass cuts

Nutrient analyzed	Unit	South African lamb (Van Heerden, 2007)			South African A2 beef (Schönfeldt, 1998)													
		Shoulder	Loin	Leg	Prime rib	Loin	Wing rib	Rump	Topside	Fillet	Silverside	Thick flank	Chuck	Brisket	Neck	Shoulder	Thin flank	Fore shin	Hind shin
Raw																			
Fat	g	9.63	11.3	21.93	21.93	21.04	23.99	19.68	16.36	6.37	12.23	13.09	16.00	32.15	19.47	13.64	32.85	9.24	16.06
Protein	g	18.0	17.8	18.99	18.99	19.06	17.15	16.90	19.28	21.16	19.22	17.87	17.93	14.26	17.98	19.56	17.24	21.00	19.03
Fatty acids																			
14:0	g	0.62	0.69	0.51	0.51	0.45	0.52	0.48	0.44	0.23	0.32	0.35	0.32	0.64	0.45	0.32	0.66	0.26	0.38
16:0	g	2.50	2.67	3.82	3.82	3.95	4.11	3.60	3.27	2.09	2.79	2.95	3.12	4.85	3.58	2.89	5.25	2.54	3.08
16.1	g	0.21	0.21	0.14	3.24	3.07	3.44	2.99	2.49	1.74	1.92	2.17	2.68	4.15	2.94	2.13	4.14	1.63	1.73
18:0	g	1.64	1.86	0.88	0.71	0.67	0.69	0.69	0.57	0.29	0.60	0.53	0.48	1.06	0.63	0.54	0.92	0.46	0.80
18:1					6.28	6.26	6.83	5.78	5.35	3.22	4.69	4.66	5.35	8.56	5.92	4.96	8.76	4.02	5.98
18:1n9t	g	0.33	0.42	0.19															
18:1n9c	g	3.53	3.70	2.14															
18:2	g				0.61	0.54	0.60	0.61	0.52	0.44	0.40	0.44	0.51	0.78	0.59	0.53	0.79	0.36	0.49
18:2n6t	g	0.03	0.02	0.02															
18:2n6c	g	0.28	0.29	0.17															
20:0	g	0.03	0.03	0.01															
20:4	g				0.03	0.03	0.02	0.63	0.02	0.05	0.01	0.03	0.03	0.03	0.04	0.05	0.04	0.02	0.04
Cholesterol	mg	64.0	61.8	62.7	68.18	62.49	68.92	72.46	70.15	66.68	70.89	70.13	71.02	75.15	75.99	69.50	70.29	76.26	72.77
Cooked																			
Fat	g	9.86	7.80	22.38	22.38	21.52	24.51	23.77	15.31	7.78	12.85	10.12	21.71	33.01	22.35	17.33	34.36	8.68	15.52
Protein	g	23.1	27.8	26.46	26.46	28.56	24.83	27.11	29.02	30.50	28.89	29.95	26.13	21.07	24.57	28.24	21.56	29.68	28.01
Fatty acids																			
14:0	g	0.50	0.47	0.42	0.51	0.47	0.54	0.53	0.34	0.22	0.29	0.21	0.40	0.68	0.48	0.40	0.66	0.24	0.42
16:0	g	2.06	1.97	1.86	3.97	4.22	4.29	4.22	3.34	2.23	2.78	2.59	3.99	5.15	4.11	3.55	5.54	2.36	3.14
16.1	g	0.20	0.18	0.16	3.40	3.18	3.66	3.67	2.51	1.95	1.98	1.80	3.41	4.26	3.23	2.53	4.56	1.56	1.76
18:0	g	1.10	1.08	1.30	0.47	0.37	0.49	0.46	0.29	0.25	0.42	0.29	0.34	0.71	0.45	0.40	0.68	0.30	0.57
18:1					0.659	6.39	6.95	6.76	5.28	3.48	5.12	4.50	6.61	9.01	6.77	5.80	9.17	4.25	5.98
18:1n9t	g	0.23	0.24	0.21															
18:1n9c	g	2.88	2.63	2.71															
18:2					0.51	0.39	0.50	0.51	0.34	0.45	0.38	0.31	0.38	0.60	0.38	0.41	0.54	0.30	0.37
18:2n6t	g	0.02	0.02	0.02															
18:2n6c	g	0.24	0.22	0.24															
20:0	g	0.02	0.01	0.02															
20:4	g				0.03	0.03	0.03	0.04	0.04	0.04	0.02	0.03	0.02	0.04	0.03	0.02	0.03	0.02	0.04
Cholesterol	mg	85.0	86.3	91.7	81.72	83.10	75.91	97.13	85.32	90.94	85.40	87.25	97.29	87.39	101.02	88.73	78.26	84.65	92.52

There is also a general perception that nutrition information is inconsistent and has thus resulted in a lack of trust in the nutrition industry (IFIC, 2006).

Taste and price are the most important criteria influencing consumer's food and beverage purchases, followed by healthfulness and convenience (IFIC, 2006). In developing countries, price is a very important determinant when purchasing food and consumers often claim they do not have the luxury to buy healthy, high priced products, although cellular phone technology was able to overcome all these barriers. Changing consumer's dietary intake is therefore more complex than just education; it must involve the provision of affordable healthy alternatives.

Cultural traditions and habits act as a further barrier to changing diet and lifestyle, where changing a barrier often means changing critical elements of a specific culture. Further research need to be done on consumer's attitudes on the above mentioned issues within a particular country context in order to determine which actions should be taken and in what manner to ensure that these barriers are overcome.

6.2. Changing the nutritional composition of red meat

Red meat is associated with various detrimental effects on health ranging from being high in fat, increasing cholesterol levels and increasing the risk for various types of cancer. By changing the nutrient content of meat, specifically the fat content and/or fatty acid ratio towards leaner products, these possible detrimental effects that meat may have can be altered to minimize/eliminate the risk. With regards to meat, one way of influencing the nutrient content of the food consumed is by modulating the diet of the monogastric animal and/or ruminant. Results indicate that the energy content of an animal's diet influence the proportions of the fatty acids present in the subcutaneous tissue (Casey & Webb, 1995). Post-slaughtering activities such as the trimming of visible fat both in store and at home as well as applying specific cooking methods can also greatly influence the fat percentage present in the edible portion (Higgs, 2000). A reduction of approximately 25% by trimming the external fat of the raw cut prior to cooking and a further reduction of 10% by removing all visible fat, totalling a 35% reduction in fat content, is reported by the Beef Information Centre (2008).

6.3. Utilizing the power of consumer education

Consumers base their purchasing decisions on the knowledge they have gained throughout their life. With the current progression in nutrition research and results showing new nutritional data and composition values, there is an increase in the need to inform the consumer of these changes to enable educated food choices.

Red meat is often associated with increase risk for various diseases; however, Wolmarans, Laubscher, & Van Der Merwe (1999) found that lean beef and mutton did not adversely affect the lipoprotein profiles of hypercholesterolaemic subjects when consumed as part of a prudent diet. Li, SinClair, Mann, & Turner (1999) also disapproved the hypothesis that meat consumption is associated with abnormal platelet functioning. These studies suggesting the possibility that red meat might not be as detrimental to health as many believe, along with new data proving that South African red meat are much lower in fat than previously thought, might be valuable information in promoting lean red meat as a healthy food option that could for part of a low fat, kJ controlled diet.

Consumers often consult product packaging for information about the expiration date, list of ingredients and nutritional information. Along with health professionals, family and friends, product labeling is one of the most important influencers in prompting consumers to make dietary changes (IFIC, 2006). Product packaging can therefore be used as a powerful education tool, not only providing nutrient content, but also relevant nutritional information about the product.

7. Conclusion

The majority of the populations in most developed countries consume meat, with developing countries increasingly so. Red meat makes a significant contribution to nutrient intake for most individuals and there is no evidence that a moderate intake of lean red meat has any negative effects on health within an obesity context. Therefore, as recommended in healthy eating guidelines around the world, lean red meat, consumed in moderation, can be promoted as part of a healthy balanced diet (Williamson et al., 2005).

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