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INFORMATION ON THE NUTRITIONAL VALUE OF SOUTH AFRICAN PORK 2023

Prepared for:

The South African Pork Producers' Organisation (SAPPO)

Human Nutrition | Menslike Voeding

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Fact 1

South African pork is classified as red meat.

Supporting Literature

The following are classified as red meat in South Africa: Bovine animals (including the species *bubalus bubalis* and bison bison), donkey, farmed deer, goat, horse, kangaroo, mule, pig, and sheep (Erasmus SW & Hoffman LC, 2017).

Red meat refers to unprocessed mammalian muscle meat (e.g., beef, veal, pork, lamb) including that which may be minced or frozen. Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking or other processes to enhance flavour or improve preservation. Most processed meats contain pork or beef but may also contain other meats including poultry and offal (e.g., liver) or meat by-products such as blood (IARC, 2018).

Red meat contains proteins of high biological value, and important micronutrients such as B vitamins, iron (both free iron and haem iron), and zinc. Pork is a frequently consumed red meat that provides substantial amounts of energy, macronutrients, and micronutrients to the diet (Penkert LP et al., 2021).

Oxygen is delivered to muscles by the red cells in the blood. One of the proteins in meat, myoglobin, holds the oxygen in the muscle. Meats are categorized as either white or red based off the amount of myoglobin found in the animal's muscle. Pork is classified a red meat because it contains more myoglobin than chicken or fish (USDA, 2023). Myoglobin and haemoglobin are the pigments that give meat its red colour. Myoglobin makes up 80-95% of the pigment concentration and contains 95% of the total muscle iron (Lindahl G, 2005).

Fact 2

Consumed in moderation, lean pork can make a good addition to a healthy diet. The South African Food-Based Dietary Guidelines recommends not more than 560 g red meat per week (approximately 80 - 90 g per day), preferably low-fat types and cuts, and cooking methods are preferable options.

Supporting Literature

Meat and meat products are nutrient dense food and an important source of a wide range of valuable nutrients such as proteins, fat, vitamins and minerals as well as some micronutrients, all of which are essential for good health. Moderate meat intake can contribute to improved nutritional status. The challenge in South Africa is to aim for 'optimal' diets and nutrient intakes of all South Africans, which should be both adequate and prudent. Foods from animals can play an important role in reaching this goal if they are eaten in the amounts recommended above (Scholtz SC et al., 2001).

Red meat (beef, veal, pork, lamb and mutton) consumption contributes several important nutrients to the diet, for example essential amino acids, vitamins (including B12) and minerals (including iron and zinc). In comparison to other animal products such as beef or lamb, pork is richer in a number of B vitamins, selenium, phosphorous and potassium, and has a comparable or lower fat content than lamb (Food Standards Australia and New Zealand, 2011). The vitamins and minerals present in pork play a range of important roles in growth and development, including fatty acid, carbohydrate and protein metabolism, DNA synthesis and the regulation of gene expression (National Health and Medical Research Council, 2006)

Increased lean pork rather than total pork intake was recently associated with improved nutrient intakes of protein, magnesium, potassium, selenium, zinc, phosphorus, thiamine, riboflavin, niacin, and vitamin B6 and with lesser increases in daily total energy, saturated fat, and sodium intakes among U.S. adults (An R et al., 2019).

Fresh lean pork therefore contains critical nutrients important for the growth and development of children and adults. It can readily be included as a regular part of a healthy dietary pattern for weight loss, diabetes and blood pressure management, mood, vitality, quality of life and cognition, quality of sleep, and general health. Fresh lean pork consumers are found to have comparable daily fat and saturated fat intake compared to non-consumers, suggesting that unprocessed fresh lean pork can be part of a healthy diet (Chowdhury R et al., 2014; McNeill SH, 2014; An R et al., 2019).

Why moderation is Important:

Despite minor differences depending on species and the animal's diet and age, saturated fatty acids (SFAs) generally constitute almost half the fat in meat, and meat contributes to approximately half of the maximal recommended intake of SFAs. Red meat, particularly cuts that are higher in saturated fat and processed meat, has been linked to increased risk for health conditions like heart disease, type 2

diabetes and some types of cancer, the latter associated with compounds created when red meat is cooked at high heat. Its environmental impact is high compared with plant sources of protein. As a means of reducing the risk of mortality and disease, dietary guidelines have, during the past 30 years, advocated limiting SFA intake to less than 10% of total dietary energy (Wang X et al., 2016; Mozaffarian D et al., 2018; FAO, 2010; Astrup A et al., 2019).

The evidence-based integrated message is that it is plausible to conclude that high consumption of red meat, and especially processed meat, is associated with an increased risk of several major chronic diseases and preterm mortality (Wolk A, 2017; Chen Z et al., 2020).

The recent meta- analysis study by Chen et al (2020): Dietary protein intake and all-cause and cause-specific mortality: results from the Rotterdam Study and a meta-analysis of prospective cohort studies: supports current dietary recommendations to increase intake of plant protein in place of animal protein.

An ideal human diet would therefore consist of both animal- and plant source foods in appropriate amounts and proportions to ensure intake of sufficient quantity and quality of proteins, while consuming adequate dietary fibre (Wu G et al., 2014).

For those who choose to consume red meat, red meat (as with all other protein-rich food sources) should be consumed in the context of a healthy eating pattern high in fruits, vegetables, and whole grains and within energy needs to reduce disease risk. If one chooses to include red meat in the diet, make sure to choose lean cuts that are lower in saturated fat. They may be labelled as “lean” or “extra lean” on the package. Cuts with the least amount of visible fat (called marbling) are also good options.

A 80 - 90 g portion per day is about the size of your hand palm or a pack of cards.

Fact 3

Lean pork meat is nutritious and a good choice of animal protein in a varied diet.

Supporting Literature

In 2008, the need for information on the quality of South African pork to address consumer uncertainties was identified by the Red Meat Producers Organisation (RPO) as being of prime importance. They subsequently requested that the quality of South African pork be investigated. The

chemical analysis on raw pork by Pieterse in 2004, showed that it is clear that, although the protein content is similar, the fat content is markedly lower than the values quoted in the current Food Composition Tables (Pieterse E, 2005; Van Heerden SM & Smith MF, 2013).

Van Heerden and Smith (2013) did a study to determine the nutrient composition of raw (fresh, not frozen) and cooked pork meat and fat samples from three pork cuts (leg, loin and shoulder) obtained from P-class (81–90kg carcasses with 70% meat and more, with a fat thickness measured by means of an intrascope of at least 1mm but not more than 12 mm fat, (National Department of Agriculture (NDA), 1990) South African pork carcasses, in order to incorporate the data into the Food Composition Tables of the Medical Research Council of South Africa to be used by the medical fraternity to make meaningful recommendations to the consumer .

Table 1. Nutritional content of lean pork meat (pooled data for leg cut, loin cut and shoulder cut).

Means for the nutrient composition of raw and cooked pork 100g muscle lean meat containing intramuscular fat			
Nutrients	**Unit**	**Raw**	**Cooked**
Protein	g	19.6	25.3
Fat	g	5.2	7.5
Energy	kJ	527	707
Minerals			
Magnesium	mg	23.74	21.83
Calcium	mg	33.2	40.5
Phosphorus	mg	188.0	170.0
Potassium	mg	323.9	290.9
Sodium	mg	76.5	77.2
Iron	mg	0.14	0.22
Zinc	mg	0.2	0.2
Vitamins			
Thiamin (B1)	mg	0.53	0.27
Riboflavin (B2)	mg	0.03	0.03
Niacin (B3)	mg	6.8	5.4
Lipids			

Total Saturated fatty acids	g	2.08	2.67
14:0	g	0.08	0.09
16:0	g	1.24	1.66
18:0	g	0.68	0.83
20:0	g	0.01	0.01
Total mono-unsaturated fatty acids	g	2.15	3.03
16:1	g	0.12	0.16
18:1n9t	g	0.06	0.03
18:1n9c	g	1.90	2.7
Total polyunsaturated fatty acids	g	1.00	1.80
18:2n6t	g	0.01	0.01
18:2n6c	g	0.87	1.57
CLA	g	5.23	7.50
Cis fatty acid	g	0.77	4.30
Trans fatty acid	g	0.06	0.04
Omega 3	g	0.05	0.10
Omega 6	g	0.91	1.63
EPA C20:5n3	g	0.010	0.001
EPA C22:6n3	g	0.002	0.001
Cholesterol	mg	40.4	70.7

Adapted from: Van Heerden SM, Smith MF. The nutrient composition of three cuts obtained from P-class South African pork carcasses. Food Chem. 2013;140(3):458-465. doi:10.1016/j.foodchem.2012.10.066

The overall percentage fat for all three cuts was less than 10% which is recommended by the South African Heart Mark.

The cooked loin cut contained the most protein (27.50g/100 g) of the three cooked cuts.

Van Heerden and Smith (2013) used The Recommend ed Dietary Allowances (RDA) for males and females, age 25–50 as a reference point to evaluate the nutrient contribution of pork.

Table 2. Contribution of a 100g edible portion of lean cooked pork (pooled data for leg cut, loin cut and shoulder cut) to the RDA nutrient requirements of females and males aged 25-50.

Nutrients	Unit	RDA females	Average % contribution of 100g cooked lean pork	RDA males	Average % contribution of 100g cooked lean pork
Protein	g	50	50	63	40.1
Energy	kJ	9169	8	12180	5.8
Minerals					
Magnesium	mg	320	6.8	420	5.2
Calcium	mg	1200	3.4	800	3.4
Phosphorus	mg	800	21.3	700	24.3
Zinc	mg	12	1.6	15	1.8
Iron	mg	15	1.46	10	2.2
Vitamins					
Thiamin	mg	1.1	24.5	1.2	22.5
Riboflavin	mg	1.3	2.3	1.3	2.3
Niacin	mg	15	36.6	16	34.3

Adapted from: Van Heerden SM, Smith MF. The nutrient composition of three cuts obtained from P-class South African pork carcasses. Food Chem. 2013;140(3):458-465. doi:10.1016/j.foodchem.2012.10.066

The Recommend ed Dietary Allowances (RDA) for males and females, age 25–50 were used as a reference point to evaluate the nutrient contribution of pork. It is evident from this study by Van Heerden and Smith (2013) that South African, P-class pork is an excellent source of nutrients that is required for good health. Lean fresh pork is a high-protein, low-fat, nutrient-packed choice for the family and compares favourably with the fat, energy, and cholesterol content of many other meats and poultry.

For men the cooked shoulder, loin and leg cuts provide on average 40.1% protein, 5.2% magnesium, 3.4% calcium, 24.3% phosphorus, 1.8% zinc, 2.2% iron and 22.5% vitamin B1, 2.67% vitamin B2 and 34.29% vitamin B3 of RDA for males, age 25–50. Energy from a 100 g portion provides 5.8% of the RDA.

For women, the cooked shoulder, loin and leg cut contributes on average 50% protein, 8% energy, 6.8% magnesium, 3.4% calcium, 21.3% phosphorus, 1.6% zinc, 1.5% iron and 24.5% vitamin B1, 1.2% vitamin B2 and 36.6% vitamin B3 of RDA for males, age 25–50.

Pork provides iron, zinc, selenium, magnesium, phosphorus, potassium, thiamine, riboflavin, niacin, pantothenic acid, choline, and vitamins B6 and B12 to the diet (FoodData Central identifier 168251; Penkert LP et al., 2021)

Recent randomized controlled trials have shown that the addition of lean pork to both the Mediterranean diet and the Dietary Approaches to Stop Hypertension diet does not affect the demonstrated benefits of these diets on established biomarkers of cardiovascular disease (Wade AT et al., 2019; Sayer RD et al., 2015; Geiker NRW et al., 2021).

Fact 4

Limit the intake of processed forms of pork meat such as bacon, pork sausages, deli meats, viennas, and polony. Chose fresh lean pork instead.

Supporting Literature

In regard to processed meat, the WHO states that such meat has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation. Most processed meats contain pork or beef, but processed meats may also contain other red meats, poultry, offal, or meat by-products such as blood. It is also necessary to highlight that processed meats include a great variety of additives, such as NaCl, nitrites, phosphates, etc (Delgado J et al., 2020).

Heterocyclic amines (HCAs) are cancer forming compounds found in processed meats, particularly well-done meats. HCAs are unintentional harmful chemical compounds formed in processed meat products at high temperatures as a result of the Maillard reaction (Olalekan ASA et al., 2021).
Consumption of processed meat and meat products with high concentrations of HCAs is linked to cancer, particularly cancers of the colon, rectum, breast, prostate, pancreas, lung, and gastrointestinal tract according to epidemiological studies (Olalekan ASA et al., 2021).

The evidence-based integrated message is that it is plausible to conclude that high consumption of red meat, and especially processed meat, is associated with an increased risk of several major chronic

diseases and preterm mortality (Wolk A, 2017; Chen Z et al., 2020). The World Cancer Research Fund/American Institute for Cancer Research recommend limiting red meat consumption to moderate amounts and consuming very little processed meat (World Cancer Research Fund, 2019).

Bacon usually has a high salt content. Excessive intake of salt could cause a harm to human health (Du H et al., 2022)

The epidemiological risk for CVD is more affected by the consumption of processed than by unprocessed meats (Ekmekcioglu et al., 2018; Micha et al., 2012). This has been suggested to be due to the content of sodium and other preservatives present in processed meat products (Micha et al., 2012). Processed meats contain around 400% more sodium and 50 % more nitrates per gram than raw meat (Micha et al., 2012). The impact of excess sodium intake on increasing blood pressure is therefore well-established and processed meat products have been recognized as a major contributor to dietary sodium in developed countries (Delgado J et al., 2020).

Fact 5

Eating high quality protein like that found in pork — as part of a healthy lifestyle that includes exercise — can help to maintain healthy muscle tissue.

Supporting Literature

Pork is a frequently consumed red meat that provides substantial amounts of energy, macronutrients, and micronutrients to the diet. Increased lean pork rather than total pork intake was recently associated with improved nutrient intakes of protein, magnesium, potassium, selenium, zinc, phosphorus, thiamine, riboflavin, niacin, and vitamin B6 and with lesser increases in daily total energy, saturated fat, and sodium intakes among U.S. adults (An R et al., 2019).

A 100g portion of cooked lean pork provides 40.1% and 50% of the RDA for protein for men and women aged 25-50 respectively (Table 2).

Meat consumption is not only beneficial for maintaining muscle mass but may also improve muscle function and physical performance.

Based on short-term nitrogen balance studies, the Recommended Dietary Allowance of protein for a healthy adult with minimal physical activity is currently 0.8 g protein per kg body weight (BW) per day. To meet the functional needs such as promoting skeletal-muscle protein accretion and physical strength, dietary intake of 1.0, 1.3, and 1.6 g protein per kg BW per day is recommended for individuals

with minimal, moderate, and intense physical activity, respectively. Chronic high protein intake (>2 g per kg BW per day for adults) may result in digestive, renal, and vascular abnormalities and should be avoided. The quantity and quality of protein are the determinants of its nutritional values. Therefore, adequate consumption of high-quality proteins from animal products (e.g., lean meat and milk) is essential for optimal growth, development, and health of humans (Wu G, 2016).

Protein in animal products has a higher digestibility (∼95%) than proteins isolated from plants (∼85–92%) or proteins in whole plant foods (∼80–85%) which generally contain anti-nutritional factors. Several lines of evidence show that animal-source protein has a greater nutritional value than plant-source protein to sustain skeletal-muscle mass (Hartman JW et al., 2007; Volek JS et al., 2013).

Aside from being rich in high-quality protein, lean pork contains a variety of healthy nutrients that are beneficial for your muscles. These include taurine, creatine, and beta-alanine (Sale C et al., 2009; Derave W et al, 2010).

An ideal human diet would consist of both animal- and plant source foods in appropriate amounts and proportions to ensure intake of sufficient quantity and quality of proteins, while consuming adequate dietary fibre (Wu G et al., 2014).

Sufficient intake of high-quality protein from animal products (e.g., lean meat and milk) is essential for optimal growth, development, and health of children, as well as for optimal maintenance, function and health of tissues (including skeletal muscle, brain, heart, kidneys, liver and gut) in adults (Wu G, 2016; Phillips SM et al., 2016).

Higher protein intakes may help prevent age-related sarcopenia, the loss of muscle mass, and strength that predisposes older adults to frailty, disability, and loss of autonomy (Rogeri PS et al., 2021).

When attempting to adhere to specific energy and macronutrient quantities, lean animal sources allow for the greatest protein content with less saturated fat en total energy.

Athletes can also benefit from higher protein intakes to maximize athletic performance given the critical role protein plays in stimulating muscle protein remodelling after exercise.

Fact 6

Pork is a rich source of many vitamins and minerals, including Thiamine.

Supporting Literature

Thiamine plays a critical role in energy metabolism and, therefore, in the growth, development, and function of cells.

Table 3. Contribution of a 100g edible portion of lean cooked pork (pooled data for leg cut, loin cut and shoulder cut) to the RDA Thiamine requirements of females and males aged 25-50.

Nutrients	Unit	RDA females	Average % contribution of 100g cooked lean pork	RDA males	Average % contribution of 100g cooked lean pork
Thiamine	mg	1.1	24.5	1.2	22.5

Adapted from: Van Heerden SM, Smith MF. The nutrient composition of three cuts obtained from P-class South African pork carcasses. Food Chem. 2013;140(3):458-465. doi:10.1016/j.foodchem.2012.10.066

Pork has been shown to have different nutritional characteristics than other sources of meat and to be, for US fresh pork consumers, an important source of protein, selenium, thiamine, and vitamin B6 (Murphy MM et al., 2011).

Based on the analysis of Van Heerden and Smith (2013) a portion of cooked lean pork provides 24.5% vitamin B1 and 22.5% vitamin B1 of the RDA for women and men aged 25-50 respectively.

Nolan-Clark D et al. (2012) did a study to determine the health benefits of pork consumption in the diets of Australian children. Following a comprehensive review of the most relevant food composition database, NUTTAB 2006 (Food Standards Australia and New Zealand, 2006) the cuts of pork selected were found to contain significantly more thiamine than beef, lamb or seafood.

Intake recommendations for thiamine and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the Institute of Medicine of the National Academies (formerly National Academy of Sciences) Institute of Medicine. The recommended daily allowance (RDA) of thiamine taken by mouth is 1.2 mg for males and 1.1 mg for

females over the age of 18 years. Pregnant or breastfeeding women of any age should consume 1.4 mg each day (Food and Nutrition Board, 1998; National Institutes of Health, 2023)

Thiamine (vitamin B1) is a water-soluble vitamin. It enables the body to use carbohydrates as energy. Vitamin B1, or thiamine, helps prevent complications in the nervous system, brain, muscles, heart, stomach, and intestines. It is also involved in the flow of electrolytes into and out of muscle and nerve cells. Thiamine-derived molecules serve as an important cofactor for numerous enzymes, notably those involved in energy production via the tricarboxylic acid (TCA) cycle. Deficiency in thiamine can lead to neurological abnormalities and congestive heart failure (HF), known as dry beriberi and wet beriberi respectively (DiNicolantonio JJ et al., 2018; Peterson CT et al., 2020).

Fact 7

Pork is a rich source of many vitamins and minerals, including Niacin.

Supporting Literature

Niacin works in the body as a coenzyme, with more than 400 enzymes dependent on it for various reactions. Niacin helps to convert nutrients into energy, create cholesterol and fats, create and repair DNA, and exert antioxidant effects (National Institutes of Health Office of Dietary Supplements, 2023).

Table 4. Contribution of a 100g edible portion of lean cooked pork (pooled data for leg cut, loin cut and shoulder cut) to the RDA Niacin requirements of females and males aged 25-50.

Nutrients	Unit	RDA females	Average % contribution of 100g cooked lean pork	RDA males	Average % contribution of 100g cooked lean pork
Niacin	mg	15	36.6	16	34.3

Adapted from: Van Heerden SM, Smith MF. The nutrient composition of three cuts obtained from P-class South African pork carcasses. Food Chem. 2013;140(3):458-465. doi:10.1016/j.foodchem.2012.10.066

Based on the analysis of Van Heerden and Smith (2013) a portion of cooked lean pork provides 36.6% niacin and 34.4% niacin of the RDA for women and men aged 25-50 respectively.

Intake recommendations for niacin and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the Institute of Medicine of the National Academies (formerly National Academy of Sciences) Institute of Medicine. The recommended daily allowance (RDA) of niacin taken by mouth is 16 mg for males and 14 mg for females over the age of 18 years. (Food and Nutrition Board, 1998; National Institutes of Health, 2023)

Niacin, or vitamin B3, is a water-soluble B vitamin found naturally in some foods. The two most common forms of niacin in food and supplements are nicotinic acid and nicotinamide. The body can also convert tryptophan—an amino acid—to nicotinamide. Niacin is water-soluble so that excess amounts the body does not need are excreted in the urine.

The Coronary Artery Risk Development in Young Adults (CARDIA) study followed 3,136 men and women ages 18-30 for up to 25 years. The study measured dietary and supplemental B vitamin intake and cognitive function. A higher intake of B vitamins, but particularly niacin, throughout young adulthood was associated with better cognitive function scores in midlife. However, cognitive function was only assessed at the end of the study, so any changes in cognitive function over time was not known (Qin B et al., 2017).

Research in this area is limited but there are several clinical trials underway that may shed further light on niacin's effects on brain health.

Fact 8

Pork is a rich source of many vitamins and minerals, including Vitamin B6.

Supporting Literature

Vitamin B6 is a water-soluble vitamin that is naturally present in many foods. Vitamin B6 in coenzyme forms performs a wide variety of functions in the body and is extremely versatile, with involvement in more than 100 enzyme reactions, mostly concerned with protein metabolism. Vitamin B6 also plays a role in cognitive development through the biosynthesis of neurotransmitters and in maintaining normal levels of homocysteine, an amino acid in the blood. Vitamin B6 is involved in gluconeogenesis and glycogenolysis, immune function (for example, it promotes lymphocyte and interleukin-2 production), and haemoglobin formation (National Institutes of Health Office of Dietary Supplements, 2023).

Table 5. Contribution of a 100g edible portion of lean cooked pork to the RDA Vitamin B6 requirements of females and males aged 19-50.

Nutrients	Unit	RDA females	Average % contribution of 100g cooked lean pork	RDA males	Average % contribution of 100g cooked lean pork
Vitamin B6	mg	1.3	30.8	1.3	30.8

MRC. Foodfinder 3, 2011

Based on the analysis of the MRC Food Finder 6 analysis programme (2011) a portion of cooked lean pork provides 30.8% Vitamin B6 of the RDA for women and men aged 25-50 respectively.

Intake recommendations for Vitamin B6 and other nutrients are provided in the Dietary Reference Intakes (DRIs) developed by the Food and Nutrition Board (FNB) at the Institute of Medicine of the National Academies (formerly National Academy of Sciences) Institute of Medicine. The recommended daily allowance (RDA) of Vitamin B6 taken by mouth is 1.3 mg for males and 1.3 mg for females over the age of 18 years. (Food and Nutrition Board, 1998; National Institutes of Health, 2023)

Fact 9

Pork is a rich source of many vitamins and minerals, including Selenium.

Supporting Literature

Pork provides substantial amounts of iron, zinc, selenium, magnesium, phosphorus, potassium, thiamine, riboflavin, niacin, pantothenic acid, choline, and vitamins B6 and B12 to the diet (FoodData Central identifier 168251; Penkert LP et al., 2021).

In comparison to other animal products such as beef or lamb, pork is richer in a number of B vitamins, selenium, phosphorous and potassium, and has a comparable or lower fat content than lamb (Food Standards Australia and New Zealand, 2011).

Based on the analysis of the MRC Foodfinder program 100g of cooked lean loin meat provides 43.9 µg of Selenium.

Based on the MRC Foodfinder data 100g of cooked loin lean meat provides 79.81% of the daily RDA for selenium for adults 19-70 years of age.

Requirements - How much do we need?
DRIs (as published by the National Academies of Science in 2001)

RDA:
males & females (19-70 years): 55 µg/day

Selenium is an essential trace element. Selenium is an essential micronutrient that plays a crucial role in development and a wide variety of physiological processes including effect immune responses. The immune system relies on adequate dietary selenium intake and this nutrient exerts its biological effects mostly through its incorporation into selenoproteins. The immune system is one aspect of human health that is impacted by dietary selenium levels and selenoprotein expression. Under conditions of selenium deficiency, innate and adaptive immune responses are impaired (Avery JC & Hoffmann PR, 2018).

Selenium is important for reproduction, thyroid gland function, DNA production, and protecting the body from damage caused by free radicals and from infection. In humans, a suitable concentration of selenium is essential for maintaining normal cellular function. Decreased levels of selenoproteins can lead to obstruction of the normal physiological functions of tissues and cells and even death.

Because of its effects on DNA repair, apoptosis, and the endocrine and immune systems as well as other mechanisms, including its antioxidant properties, selenium might play a role in the prevention of cancer (Sunde RA, 2006; Rayman MP, 2012; Allen NE et al, 2008)

Current evidence on selenium and its effects on cancer is conflicting. Vinceti et al, 2018 did a third updated review of the of the Cochrane review "Selenium for preventing cancer". They concluded that well-designed and well-conducted RCTs have shown no beneficial effect of selenium supplements in reducing cancer risk (high certainty of evidence). Some RCTs have raised concerns by reporting a higher incidence of high-grade prostate cancer and type 2 diabetes in participants with selenium supplementation. No clear evidence of an influence of baseline participant selenium status on outcomes has emerged in these studies. Observational longitudinal studies have shown an inverse

association between selenium exposure and risk of some cancer types, but null and direct relations have also been reported, and no systematic pattern suggesting dose-response relations has emerged.

Overall, there is no evidence to suggest that increasing selenium intake through diet or supplementation prevents cancer in humans. However, more research is needed to assess whether selenium may modify the risk of cancer in individuals with a specific genetic background or nutritional status, and to investigate possible differential effects of various forms of selenium (Vinceti M et al., 2018).

Kuria et al, 2020, did a study to assess the association between dietary intake of selenium and incidence of cancers by performing systematic review and meta-analysis of population-based prospective studies. Selenium at recommended daily allowance levels of ≥55 µg/day decreased the risk of cancer. A protective effect was found in men at levels ≥55 µg/day. Extra selenium intake from supplements was protective at levels ≥55 µg/day. There was an inverse relationship between selenium intake and overall cancer risk after adjusting for age, body mass index, and smoking but there was no evidence of nonlinear relationship. The findings in this study suggest that selenium is protective against cancer however the effects vary with different cancers. There is insufficient evidence so far to conclude on the association between dietary selenium intake and breast and bladder cancers. There is need for further research on selenium and these specific cancers because of the inconsistent findings (Kuria A et al., 2020; Xia X et al., 2021).

Optimum dietary intake of selenium is recommended. High-dose supplementation is not recommended for cancer prevention.

Fact 10

Lean fresh pork is a healthy protein source to incorporate in a weight loss diet.

Supporting Literature

Most dietary guidelines recommend daily consumption of lean meat to deliver key nutrients such as protein, thiamine, niacin, vitamin B12 and zinc. Eating more pork may be helpful for those working to reduce their weight. A study of 164 overweight adults found those who increased the number of servings of pork weekly lost weight, reduced their waist circumference and % body fat, compared to those who ate more chicken and beef. After 3 months, there were significant reductions in weight, BMI, waist circumference, % body fat, fat mass and abdominal fat in the pork group relative to

controls, which persisted for 6 months. There was no change in lean mass, indicating that the reduction in weight was due to loss of fat mass. There were no significant effects on other metabolic parameters. Regular consumption of lean fresh pork may improve body composition (Murphy KJ et al., 2012).

This study found no change in a selection of CV risk factors following regular consumption of fresh lean pork for 6 months. These results are in agreement with Coates et al. (2009) who showed that consumption of 1 kg of fresh pork per week for 12 weeks had no adverse effect on blood lipids. (Coates AM et al., 2009).

An R et al., 2020 did a study to systematically synthesized scientific evidence on pork consumption in relation to body weight and composition among adults. Twelve studies met the eligibility criteria and were included in the review. Meta-analysis found that among the experimental studies without energy restrictions, pork intake was associated with a reduction in body weight by 0.86 kg and body fat percentage by 0.77%; among the experimental studies with energy restrictions, pork intake was associated with a reduction in body weight by 5.56 kg, lean mass by 1.50 kg, and fat mass by 6.60 kg; and among the observational studies, pork intake was not associated with overweight or obesity status (An R et al., 2020).

It is thought that pork consumption may improve body composition and lean mass through increasing satiety, enhancing thermogenesis, and facilitating glycaemic control (An R et al., 2020)

Higher protein diets are reported to improve satiety and lead to greater reductions in body weight and fat mass compared with standard protein diets and may therefore serve as a successful strategy to help prevent and/or treat obesity (Leidy HJ et al., 2015). Increased lean pork rather than total pork intake was recently associated with improved nutrient intakes of protein, magnesium, potassium, selenium, zinc, phosphorus, thiamine, riboflavin, niacin, and vitamin B6 and with lesser increases in daily total energy, saturated fat, and sodium intakes among U.S. adults (An R et al., 2019)

McArthur JO et al., 2014 did a study to determine the quality of women's diets relative to the Australian Guide to Healthy Eating (AGHE); and to evaluate dietary changes during an intervention trial with pork meat or an iron supplement. A 12-week randomized trial was conducted in young women who were assigned to one of three groups. They maintained three, seven-day food diaries while continuing their routine diet; taking an iron supplement; or incorporating into their diets 500

g/week of pork. Participants allocated to the pork diet group were asked to incorporate a minimum of 500 g of pork meat (3–4 serves) into their meals each week without reducing their current intake of red meat. They were given free choice as to serving size, time of consumption or method of preparation. Participants in the pork diet group consumed significantly fewer energy-dense nutrient-poor "extra" foods, and ate fruit more frequently than subjects in the other groups.

Pork can be an easy protein to include in your meals. Some cuts, like pork tenderloin or boneless pork chops, cook in under a half hour, making them an excellent option for busy nights. (How Pork Affects Your Metabolic Health. Available at: https://www.signos.com/blog/pork-metabolic-health. Accessed on 13 April 2023)

Fact 11

Moderate intake of lean fresh pork meat as part of a healthy varied diet does not increase heart disease risk.

Supporting Literature

When unprocessed red meat is assessed independently of processed meats in meta-analyses, unprocessed red meat neither increases risks of developing or dying from CVD (Micha R et al., 2012; van den Brandt PA, 2019) nor negatively influences CVD risk factors (O'Connor LE et al., 2017; Guasch-Ferre M, 2019).

Monfort-Pires M et al., 2023 did a four-arm crossover study, to investigate the impact of consuming cheese, beef, and pork meat on classic and new cardiovascular risk markers (obtained from lipidomics) in the context of a healthy diet. Thirty-three young healthy volunteers were assigned to one out of four test diets. Each test diet was consumed for 14 days, with a 2-week washout. Participants received a healthy diet plus Gouda- or Goutaler-type cheeses, pork, or beef meats. Before and after each diet, fasting blood samples were withdrawn. A reduction in total cholesterol and an increase in high density lipoprotein particle size were detected after all diets. Only the pork diet upregulated plasma unsaturated fatty acids and downregulated triglycerides species.

They observed that the consumption of a healthy diet with pork meat resulted in the greatest benefits to CVD risk by improving the lipid profile, downregulating TGs and ceramide lipid species, and upregulating ether lipids, especially plasmalogens, when compared to the other test diets. They found a beneficial impact on the lipoprotein profile after the pork diet. LDL cholesterol and LDL-TG, as well

as total TGs in lipoproteins, non-HDL cholesterol, VLDL and IDL-cholesterol, VLDL-TG, IDL-TG, HDL-TG, VLDL-P, small VLDL-P, large VLDL-P, LDL-P, and non-HDL-P were significantly reduced after the pork diet, resulting in a better overall cardiovascular risk profile.

Recent data from an Australian study indicate that adding pork to a Mediterranean diet does not affect the lipoprotein profile (Wade et al., 2019). A plausible explanation for this is that the contents of MUFAs (almost 50% of total fat content) and PUFAs (17% of total fat content), as well as a lower SFA content, in the pork meat could have influenced the outcome (Monfort-Pires M et al., 2023). The Mediterranean diet is characterised by the high consumption of extra virgin olive oil, vegetables, fruits, grains, legumes and nuts; moderate consumption of fish, poultry, eggs, dairy products and red wine; and low consumption of red meat and commercial sweets. The study examined the cardiovascular effects of including 2–3 serves per week of fresh lean pork as a part of a Mediterranean dietary pattern for use in Australia. Participants were advised to consume no more than 400 g/week. A 24-week randomised controlled parallel cross-over design compared a Mediterranean diet supplemented with 2–3 serves per week of fresh, lean pork with a low-fat control diet. Thirty-three participants at risk of CVD followed each intervention for 8 weeks, with an 8-week washout period separating interventions. Compared with the Mediterranean pork intervention, the low-fat diet intervention led to greater reductions in weight and waist circumference.

But no significant differences were observed for blood pressure, lipids, glucose, insulin or CRP. These findings indicate that Australians are capable of adhering to a Mediterranean diet with 2–3 weekly serves of fresh, lean pork. Larger intervention studies are now required to demonstrate clinical efficacy of the diet in populations with elevated blood pressure (Wade et al, 2019).

Coates et al. (2009) showed that consumption of 1 kg of fresh pork per week for 12 weeks had no adverse effect on blood lipids. We need to highlight that recommended moderate intake is 560g (portion of 80-90g per occasion) per week.

The subcutaneous FA composition of industrial pigs is, 36% SFA, 44% monounsaturated fatty acids (MUFA) and 12% PUFA (Pietro Lo Fiego, Mocchioni, Minelli & Santoro, 2010).

The lipid content of muscle ranges from 1.5% to 13%. Most of these lipids are present in the adipose tissues but some of these lipids are found intracellularly in muscle fibres, this is known as marbling. Marbling is intramuscular fat that is deposited within the muscle, in a loose network of perimysial

connective tissues, between the muscle bundles. Consumers rate pork with high amounts of marbling as more tender, juicy and flavourful (Arkfeld et al., 2017)

Fact 12

Moderate intake of lean fresh pork meat as part of a healthy varied diet does not increase diabetes disease risk.

Fact 13

Consumed in moderation, lean fresh pork can make a good addition to a healthy diabetic diet.

Supporting Literature

O'Connor LE et al., 2021 conducted a meta-analysis of randomized controlled trials assessing effects of total red meat intake on glycaemic control and inflammation biomarkers in adults who are disease-free but may be at risk of developing cardiovascular disease or Type 2 diabetes mellitus at a later life stage. This current meta-analysis and past meta-analyses of RCTs (O'Connor LE et al., 2017; Guasch-Ferre M et al., 2019) show that red meat intake (mainly unprocessed beef and pork) does not affect short-term changes in cardiometabolic disease risk factors for individuals who are free of, but at risk for, CVD or T2DM. It is important to note that research participants were asked to consume lean and unprocessed red meat in most of the included articles, so evidence regarding independent effects of processed or fatty red meat intake on these outcomes is lacking.

Sanders LM et al., 2023 conducted a systematic review and meta-analysis randomized controlled trials to evaluate the effects of diets containing red meat (beef, pork, lamb, etc.), compared to diets with lower or no red meat, on markers of glucose homeostasis in adults. The results of this meta-analysis of RCTs did not show an effect of red meat on glycaemic and insulinemic biomarkers associated with the development of T2D. There was no significant effect of diets containing red meat, compared to diets with little or no red meat, on fasting glucose, fasting insulin, postprandial insulin, insulin sensitivity, HOMA-IR, HbA1c, pancreatic beta-cell function, or GLP-1.

Ahima RS et al., 2013 did a systematic review to assess experimental human studies of the impact of pork intake compared with other protein sources on early markers for the development of diabetes, i.e., insulin resistance, glucose intolerance, and the components of the metabolic syndrome. They concluded that the glucose-insulin response following the pork meals did not differ compared with

beef, shrimp, or mixed sources of proteins. However, compared with eggs, ham (processed meat) led to a larger insulin response in nonobese subjects. Compared with whey, ham led to a smaller insulin response and a larger glucose response. These findings suggest possible mechanisms for the association between processed meat and the development of diabetes. They stressed that experimental studies in humans designed to test the impact of pork intake on glucose-insulin metabolism, markers of metabolic syndrome, or mechanisms leading to the development of diabetes are limited, but, in general, suggest no differences compared with other sources of protein (Ahima RS et al., 2013).

There is no conclusive evidence to support a "one-size-fits-all" dietary strategy to improve glycaemic control and insulin resistance in Diabetic Patients (O'Connor LE et al., 2021). Experimental and observational data, summarized by the American Diabetes Association, show that the adoption of eating patterns with both low (such as Mediterranean-style or dietary approaches to stop hypertension–style diets) and high red meat intakes (such as low- and very low–carbohydrate eating patterns) improve HbA1c values, body weights, and diabetes risks (Evert AB et al., 2019; SEMDSA, 2017).

SEMDSA (Society for Endocrinology, Metabolism and Diabetes of South Africa) is a scientific society open to all persons interested in endocrinology, metabolism and diabetes. SEMDSA aims to further the clinical practice; to promote both clinical and scientific research as well as publication into all branches of Endocrinology, Metabolism and Diabetes.

The 2012 SEMDSA guidelines refer to the healthy diabetes plate model to encourage healthy eating. The recommendation on meat: *Fill the last quarter of the plate with meat and meat substitutes, such as skinless chicken and turkey portions, fish and other seafood, lean cuts of beef and pork (e.g. sirloin, fillet or pork loin), tofu, soya, eggs and low-fat cheese. Avoid processed meats (e.g. salami, Vienna sausages and polony), which are high in fat and salt* (SEMDSA 2012).

Fact 14

What about Pork fat?

Supporting Literature

Dietary fat is an essential nutrient and source of energy required for many functions in the body. Fat is the most concentrated source of energy in the diet and provides 37 kJ per gram compared to 17 kJ per gram from either carbohydrates or protein and 29 kJ per gram from alcohol (NICUS factsheet: Fats and oils: choose sensibly).

Types of fatty acids – structure and characteristics and dietary sources

The fat in food does not only consist of one type of fat but it is a mixture of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). SFA contain no double bonds, MUFA contain one double bond and PUFA contain more than one double bond. PUFA are further classified based on the position of the first double bond from the methyl end of the carbon chain.

Saturated fats: SFA refers to the major SFA in our diet, namely myristic (C14), palmitic (C16) and stearic (C18), except in the case of milk and coconut oil where SFA range from butyric (C4) to stearic (C18). Animal fat such as beef and lamb fat, lard, skin from poultry, milk fat, e.g. cream, butter, cheese, and other dairy products made from whole or low-fat (2%) milk and some vegetable fats are important sources of saturated fat in the diet. Many confectionery products, commercially prepared snacks and fried food such as convenient food or fast food can also contain high levels of saturated fats. Some plant foods (tropical oils), such as palm oil, palm kernel oil, and coconut oil are relatively high in saturated fats. Coconut oil contains approximately 92.1% SFA, 6.2% MUFA, 1.6% PUFA. It is used as cooking oil, to make margarine and is a component of many processed foods. Palm oil is semisolid at room temperatures. Palm oil contains several saturated and unsaturated fats in the forms of glyceryl laurate (0.1%, saturated), myristate (0.1%, saturated), palmitate (44%, saturated), stearate (5%, saturated), oleate (39%, monounsaturated), linoleate (10%, polyunsaturated), and linolenate (0.3%, polyunsaturated). Palm kernel oil and coconut oil are more saturated than palm oil.

Animal fats contain predominantly palmitic acid and stearic acid and tropical oils contain high amounts of SFAs, such lauric, palmitic and myristic acid.

***Trans* fats:** *Trans* fats are formed by the partial hydrogenation of unsaturated fatty acids. *Cis* and *trans* are terms that refer to the arrangement of chains of carbon atoms across the double bond. In the *cis* arrangement, the chains are on the same side of the double bond, resulting in a kink. In the *trans* arrangement, the chains are on opposite sides of the double bond, and the chain is straight. *Trans* fatty acid (TFA) is the common name for unsaturated fat with *trans*-isomer fatty acid(s). The

process of hydrogenation adds hydrogen atoms to unsaturated fats, eliminating double bonds and making them into partially or completely saturated fats. These more-completely saturated fats have higher melting point, which makes them more attractive for baking, and the saturation extends their shelf-life. Cakes, commercial cookies, chips, fried chicken, breaded chicken and fish nuggets as well as salty snack foods such as popcorn, crisps and crackers made with partially hydrogenated vegetable oils, traditional vegetable shortening or hard ("stick") margarine typically contain trans fats. Trans fats occur naturally in products of animal origin, although to a limited extent. TFA are present in ruminant meat (beef) and milk fats as a result of biohydrogenation of unsaturated fatty acids in the rumen. The major TFA in ruminant meat and milk is vaccenic, with smaller amounts of other TFA. (Soft margarines are high in polyunsaturated fatty acids and typically contain no or very low levels of TFA). (NICUS factsheet: Fats and oils: choose sensibly, 2010)

Unsaturated Fats: Unsaturated fats consist of monounsaturated and polyunsaturated fats.

Monounsaturated: MUFA refers to the major monounsaturated fatty acid in Western diets, which is oleic acid (C18:1n-9). MUFA are present in vegetables, vegetable oils, nuts, seed oils, as well as in meat, chicken and dairy products. Oleic acid is present in high amounts in olive oil, canola oil, high oleic sunflower oil, and other mid- and high oleic vegetable oils, peanuts, pistachios, almonds, and avocados.

Polyunsaturated: PUFA refers to the major PUFA in our diet, which includes mainly linoleic acid (LA) (C18:2n-6), a lower proportion of alpha-linolenic acid (ALA) (C18:3n-3), and depending on seafood intake a variable but relatively low proportion of long chain PUFA such as arachidonic acid (AA), Eicosapentaenoic acid (EPA), Docosapentanoic Acid (DPA) and Docosahexaenoic Acid (DHA). PUFA are found in vegetable oils (soybean oil, corn oil and safflower oil), fish, especially oily fish (salmon, mackerel, herring, trout, sardines and snoek), and most nuts and seeds. ALA can be converted by the body into EPA and DHA, but only about 2 - 10% is converted. The human body cannot synthesize ALA and linoleic acid (LA), an omega-6 fatty acid, making it essential fatty acids since it needs to be obtained from dietary sources (NICUS factsheet: Fats and oils: choose sensibly, 2010).

Diets high in saturated fatty acids and trans fatty acids increase low-density lipoprotein (LDL) cholesterol levels, one of the risk factors of CHD. Not all saturated fatty acids increase LDL cholesterol. Lauric (C12:0), myristic (C14:0) and palmitic (C16:0) acids increase LDL cholesterol whereas stearic (C18:0) has no effect. There is convincing evidence that replacing SFA with PUFA decreases the risk of CVD. When polyunsaturated fats replace saturated fats in the diet, this could help to reduce blood cholesterol concentrations and thus lower the risk of CVD. A similar but lesser

effect is achieved by replacing SFA with monounsaturated fatty acids (MUFA) (NICUS factsheet: Fats and oils: choose sensibly, 2010).

Dietary fat goals:

Less than 30% of total energy intake from fats (Hooper L et al., 2015; WHO/FAO Expert Consultation, 2003; FAO, 2010). Unsaturated fats (found in fish, avocado and nuts, and in sunflower, soybean, canola and olive oils) are preferable to saturated fats (found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard) and trans-fats of all kinds, including both industrially-produced trans-fats (found in baked and fried foods, and pre-packaged snacks and foods, such as frozen pizza, pies, cookies, biscuits, wafers, and cooking oils and spreads) and ruminant trans-fats (found in meat and dairy foods from ruminant animals, such as cows, sheep, goats and camels). It is suggested that the intake of saturated fats be reduced to less than 10% of total energy intake and trans-fats to less than 1% of total energy intake (WHO, 2018). In particular, industrially-produced trans-fats are not part of a healthy diet and should be avoided (WHO/NMH/NHD/18.4. Geneva: World Health Organization; 2018). Therefore, in view of the positive linear relationship among dietary saturated fat, LDL cholesterol, and cardiovascular disease (CVD) risk, saturated fat should be limited to less than 10% of total energy intake in order to prevent CVD. For those at risk of cardiovascular disease the intake should be less than 7% of energy.

Pork fat:

As in many other countries, South Africa is actively involved in analysing foods for the compilation of food composition data. Currently, only 37% of all South African food values in the Medical Research Council's (MRC) tables are derived from South African foodstuffs (SAFOOD, 2011). The current data on pork that appear in the MRC's food composition tables of 1999 are derived from the United States Department of Agriculture (USDA)database.

Van Heerden and Smith (2013) did a study to determine the nutrient composition of raw (fresh, not frozen) and cooked pork meat and fat samples from three pork cuts (leg, loin and shoulder) obtained from P-class (81–90kg carcasses with 70% meat and more, with a fat thickness measured by means of an intrascope of at least 1mm but not more than 12 mm fat, (National Department of Agriculture (NDA), 1990) South African pork carcasses.

Table 6. Nutritional fat and lipid content of lean pork meat (pooled data for leg cut, loin cut and shoulder cut).

Means for the nutrient composition of raw and cooked pork 100g muscle lean meat containing intramuscular fat			
Nutrients	**Unit**	**Raw**	**Cooked**
Fat	g	5.2	7.5
Lipids			
Total Saturated fatty acids	g	2.08	2.67
14:0	g	0.08	0.09
16:0	g	1.24	1.66
18:0	g	0.68	0.83
20:0	g	0.01	0.01
Total mono-unsaturated fatty acids	g	2.15	3.03
16:1	g	0.12	0.16
18:1n9t	g	0.06	0.03
18:1n9c	g	1.90	2.7
Total polyunsaturated fatty acids	g	1.00	1.80
18:2n6t	g	0.01	0.01
18:2n6c	g	0.87	1.57
CLA	g	5.23	7.50
Cis fatty acid	g	0.77	4.30
Trans fatty acid	g	0.06	0.04
Omega 3	g	0.05	0.10
Omega 6	g	0.91	1.63
EPA C20:5n3	g	0.010	0.001
EPA C22:6n3	g	0.002	0.001
Cholesterol	mg	40.4	70.7

Adapted from: Van Heerden SM, Smith MF. The nutrient composition of three cuts obtained from P-class South African pork carcasses. Food Chem. 2013;140(3):458-465. doi:10.1016/j.foodchem.2012.10.066

The fat content in pork, like any product, is now viewed as a complex of fatty acids that play both positive and negative roles in the prevention of metabolic diseases such as atherosclerosis, myocardial infarction, stroke, obesity, type 2 diabetes, etc (Poklukar, K et al, 2020).

The generally accepted dietary recommendations aim at an overall reduction in saturated fatty acid intake and an increase in unsaturated fatty acid intake (UFA). There is a cognitive distortion among the population that pork contains saturated fatty acids exclusively.

Currently the only South African analysis data is from Van Heerden & Smith (2014). Based on the analysis of Van Heerden & Smith (2014) cooked pork fat contains **36% saturated fatty acids, 40.4% monounsaturated fatty acids and 24% polyunsaturated fatty acids.** It is important to note that the Fatty acid (FA) composition of pork is affected by many factors: genotype, breeding, gender and feeding methods (Vargas MEG, 2013).

Recently Lebret & Candek-Potokar (2021) reported the following in a review on the impact of production factors, slaughter methods, carcass processing, and post mortem ageing on fresh meat quality: Saturated fatty acids account for 35–45 % of total fatty acids, while monounsaturated fatty acids are predominant in pig muscles and backfat where they account for 42–52% of total fatty acid, and close to 60% in certain fatty breeds (Mourot, 2009; Poklukar et al., 2020). Oleic acid C18:1 is the main tissue fatty acid (over 40% of total fatty acid). The proportion of poly-unsaturated fatty acid is lower and the most variable (5–20% of total) depending on factors related to carcass adiposity (breed, sex) and rearing (especially diet). The proportion of n-3 poly-unsaturated fatty acid is generally much lower than that of n-6 poly-unsaturated fatty acid (0.8–1.5% versus 5–18% of total fatty acid), resulting in a n-6:n-3 ratio of about 15, much greater than the recommendation for human diets (<5) with the ratio of linoleic (C18:2 n-6) to linolenic (C18:3 n-3) acid ranging between 15 and 30 for conventional pork (Mourot, 2009).

Lean fresh pork can be enjoyed as part of a healthy varied diet. Total fat intake should not exceed 30% of total energy intake and saturated fat intake should be limited to less than 10% of total energy intake.

Fact 15

What about pork meat allergy?

Supporting Literature

A pork allergy is an adverse immune response after consuming pork and its by-products. Meat allergy is relatively uncommon, although the overall incidence and prevalence of allergies to meat in the general population are not known. Among patients with food allergies, meat allergy has been reported in about 3 to 15 percent of paediatric cases (Crespo JF et al., 1995; 94. Steinke M et al., 2007) and 3 percent of adult cases (Cahen YD et al., 1998). The low prevalence of meat allergy may be in part attributable to the fact that most meats are eaten in cooked forms, and cooking usually reduces the immunogenicity of allergens (Commins SP, 2023).

Meat from any kind of mammal beef, lamb, pork, goat, and even whale and seal, can cause an allergic reaction (American College of Allergy. Asthma and Immunology, 2019).

There is some evidence of cross reactivity between eating pork and allergic reaction to cat skin. People develop this pork allergy sensitivity due to an allergic response to cat serum albumin that cross-reacts with albumin in pork. This is known as Pork-Cat Syndrome. With a cross-reactivity, the body reacts to something that resembles a substance you are allergic to. In the case of pork, it's usually cat allergens. A small number of people who are allergic to cats may also get allergic reactions to eating pork.

A more recent and commonly known syndrome associated with pork allergy is Alpha-gal syndrome. This is when a person is bitten by a tick. The tick passes on a carbohydrate called galactose-alpha-1,3-galactose (also known as alpha-gal). This carbohydrate causes an immune reaction to make IgE antibodies. This is an unusual syndrome as it is caused by a carbohydrate and not a protein and because it often causes delayed IgE allergic reactions unlike classic IgE reactions which are very quick. Alpha-gal syndrome is therefore a type of food allergy. It makes people allergic to red meat and other products made from mammals (Wilson JM et al., 2019). The symptoms of an alpha-gal allergic reaction usually take longer to start compared with those of other food allergies. Most reactions to common food allergens — peanuts or shellfish, for example — happen within minutes after you are exposed to them. In alpha-gal syndrome, reactions usually appear about 3 to 6 hours after you are exposed. Foods that can cause a reaction include: red meat, such as beef, pork or lamb. Also organ meats and products made from mammals, such as gelatins or dairy products (Mayo Clinic, 2023).

Although rare, it is possible to be allergic or sensitive to pork meat. Please seek medical diagnosis and advise if any symptoms are experienced after consumption of pork meat.

Symptoms of a red meat allergy can include:

- hives or an itchy rash
- digestive upset such as nausea, vomiting, heartburn, indigestion, diarrhea, and severe stomach pain
- difficulty swallowing
- swelling of lips, throat, tongue, or eyelids
- dizziness or faintness
- a drop in blood pressure
- shortness of breath or difficulty breathing

Alpha-gal syndrome is unique in that symptoms do not begin until 3 to 6 hours (Healthline, 2023).

Fact 16

Select lean cuts. Opt for lean cuts of leg, loin and shoulder meat.

Supporting Literature

Choosing lean meat helps people adhere to experts' guidelines for health, including saturated fat intake. Through changes in feeding and breeding techniques, pork producers have responded to consumer demand for leaner pork. Today's pork has 16% less fat and 27% less saturated fat than 15 years ago. Many cuts of pork are as lean as skinless chicken (Van Heerden & Smith, 2013; Kittel, 2006). Lean meats such as fresh lean pork are nutrient-dense sources of protein and several other nutrients. A serving (85 g) of roasted pork tenderloin, for example, provides 22 g of protein, approximately 3 g of total fat, 1 g of saturated fat, and 62 mg of cholesterol while also providing an excellent source (≥20% of the daily value) of selenium, thiamine, niacin, vitamin B6, and phosphorus and a good source (10% to 19% of the daily value) of riboflavin, zinc, and potassium (USDA National Nutrient Database for Standard Reference).

Both pork tenderloin and pork sirloin meet the American Heart Association (2021) Heart Health Checkmark criteria, which means that they contain ≤5 g of fat, ≤2 g of saturated fat, and ≤480 mg of sodium per label serving (Penkert et al., 2021). Lean pork cuts are also approved as part of the South African Heart and Stroke Foundation's eating plan, which means that fresh pork can play a starring role in your weekly meal planning.

Pork, tenderloin, lean

Pork tenderloin is the leanest type of pork you can buy, and lean cuts provide only slightly more than 2% fat by raw weight (Nutrition Advance, 2021; https://fdc.nal.usda.gov/fdc-app.html#/food-details/168249/nutrients).

Table 7. Energy, fat, and protein for pork tenderloin by raw and cooked (roasted) weight.

Nutrient	Per 100g raw	Per 100g cooked
Energy	457.8 kJ	600.6 kJ
Fat	2.17g	3.51g
Saturated fat	0.70g	1.20g
Protein	21.0g	26.2g

Adapted from Nutrition Advance. 20 of the Leanest Cuts of Meat. Available At: https://www.nutritionadvance.com/leanest-cuts-of-meat/

Pork, top loin (chops), lean

Pork top loin chops are among the leanest cuts of pork, with only 3% fat by raw weight (Nutrition Advance, 2021).

Table 8. Energy, fat, and protein content of pork top loin by raw and cooked (roasted) weight

Nutrient	Per 100g raw	Per 100g cooked
Energy	533.40 kJ	726.6 kJ
Fat	3.42g	6.28g
Saturated fat	1.21g	1.93g
Protein	22.4g	27.2g

Adapted from Nutrition Advance. 20 of the Leanest Cuts of Meat. Available At: https://www.nutritionadvance.com/leanest-cuts-of-meat/

Seven cuts of pork meet USDA guidelines for “lean,” meaning that they have less than 10 g fat, 4.5 g saturated fat and 95 mg cholesterol per 3-ounce cooked serving. Pork tenderloin actually qualifies as “extra lean,” making it as lean as a skinless chicken breast!

- Tenderloin

- Boneless Top Loin Chop
- Boneless Top Loin Roast
- Bone-In Center Loin Chop
- Bone-In Rib Chop
- Bone-In Sirloin Roast

Shopping tips for healthy pork choices:
Look for lean cuts with less than 3 millimetres of visible fat.
This can include a wide variety of cuts, such as fillets, loin, roast or chops, lean pork mince, and even pork goulash.

Moderate your portions.
The South African Pork Producers Association notes that households can safely eat up to 560 grams of lean pork divided over five or six meals each week for a balanced, heart-healthy diet.

Select high quality brands and fresh products.
Choose fresh cuts from quality, trusted brands with lower fat, sodium, and cholesterol content for most nutritional benefit (Diabetes South Africa, 2023).
Trim off visible pork fat before cooking to reduce your saturated fat intake.

Fact 17

Pork meat is safe and commercial fresh lean pork products does not contain harmful parasites.

Supporting Literature

Humans acquire foodborne parasites through meat, water or faecal contamination of both food and water. The major meat borne parasites include the protozoa Toxoplasma gondii and Sarcocystis spp., and the helminths Trichinella spp. and Taenia spp. Interestingly, although consumption of other meat types may be a transmission route for some of these parasites, only pork can be a source of all four (Djurković-Djaković et al., 2013).

Trichinella spp. causes human trichinellosis by means of the consumption of raw or inadequately treated meat from domestic or game animals. Trichinella infection is a health issue for humans and has a negative impact on the pork meat market, generated by people's fear of becoming infected with

the parasite (Ribicich et al., 2020). Humans can develop trichinosis (trichinellosis) by eating undercooked meat infected with Trichinella roundworms. Cooking meat at recommended temperatures can help prevent being infected. There is a myth that pork is the only meat that may contain a parasite called trichinosis. In fact, Trichinosis is a parasitic disease caused by eating raw or undercooked pork, wild game or rodents such as bears, wolves, seals, wild boars and rats. Because of current feeding standards and practices in pork production, trichinosis has become extremely rare in the United States. If the parasite was present in meat, it would be killed at cooking temperatures above 60 degrees Celsius. So, with the recommended cooking temperature for pork at 63 degrees Celsius, there is no risk of the parasite surviving (Pozio, 2014; Jacksonville, 2019). While human risk for trichinellosis has historically been linked to pork, modern pork production systems and slaughter inspection programs have reduced or eliminated pork as a source for trichinellosis in many countries (Rostami et al., 2017).

Generally, prevention may be carried out at four levels, including farm, slaughter, post-slaughter processing and consumer level (Djurković-Djaković et al., 2013).

At farm level, implementation of good management measures may lead to parasite-free farms. Strategies to reduce the level of parasite infection in pigs include raising animals in controlled zoo-hygienic conditions in strictly managed intensive-type farms (rodent control, no access for cats, feed and water control, no access for pigs to refuse) (Djurković-Djaković et al., 2013; Pozio, 2014).

In Western Europe, raising pigs indoors with proper sanitation has been responsible for complete elimination of Ta. Solium and has been associated with the decrease of human toxoplasmosis cases (European Food Safety Authority, 2011)

Prevention at slaughterhouse level comprises veterinary inspection at slaughter. This may, however, be limited by the applicability and sensitivity of the described diagnostic methods. Training of technicians, quality assurance and accreditation are compulsory measures. Organic pork and wild boar meat should be systematically examined for Trichinella (Djurković-Djaković et al., 2013).

Post-slaughter methods refer to pork pre-market processing and include procedures such as freezing and curing to inactivate the parasites; performance of these procedures varies with the species of parasite (Djurković-Djaković et al., 2013).

The last front is prevention at individual consumer level, which relies on sufficient cooking of meat, i.e. until pork turns light brown. Microwave cooking is not sufficient to inactivate all parasite larvae or cysts (MedicineNet, 2022). For Trichinella, various European and international regulations and guidelines have been developed to protect consumers from exposure (Dupouy-Camet, 2007; Gamble et al., 2000).

For safety, the USDA recommends cooking ground pork patties and ground pork mixtures such as meat loaf to 71°C. Cook all raw pork steaks, chops, and roasts to a minimum internal temperature of 63 °C as measured with a food thermometer before removing meat from the heat source. For safety and quality, allow meat to rest for at least three minutes before carving or consuming. For reasons of personal preference, consumers may choose to cook meat to higher temperatures. (North Dakota State University, 2021).

Fact 18

Eating pork meat does not cause tonsillitis.

Supporting Literature

Tonsillitis is inflammation of the tonsils. It's usually caused by a viral infection or, less commonly, a bacterial infection. Most cases of tonsillitis are caused by a viral infection (Mayo Clinic 2023).

Viruses known to cause tonsillitis include: rhinoviruses, the influenza virus, parainfluenza virus, enteroviruses, adenovirus and the rubeola virus. In rare cases, tonsillitis can also be caused by the Epstein-Barr virus, which causes glandular fever. Bacterial tonsillitis can be caused by a number of different bacteria, but it's usually due to group A streptococcus bacteria (NHSinform, 2023).

There is no risk of getting tonsillitis by eating pork meat.

Fact 19

Correct cooking of pork.

Supporting Literature

Pork today is very lean, making it important to not overcook and follow the recommended pork cooking temperature. The safe internal pork cooking temperature for fresh cuts is 63°C (145° F). To check doneness properly, use a digital cooking thermometer. When cooked to this temperature, pork may still have just a hint of pink in the middle, for instance inside a cooked roast or very thick chop. For safety, the USDA recommends cooking ground pork patties and ground pork mixtures such as meat loaf to 71°C. For safety and quality, allow meat to rest for at least three minutes before carving or consuming. For reasons of personal preference, consumers may choose to cook meat to higher temperatures. (North Dakota State University, 2021). Pork does not need to be cooked at extreme temperatures to be safe to eat.

It is always best to use alternative cooking methods such as roasting, steaming, boiling and grilling to avoid adding fats and oils to food and recipes. Recipes and foods that require frying and deep fat frying should be limited and preferably only be eaten on special occasions and in small quantities. Remove all visible fat before cooking.

Fact 20

Pork meat is a healthy and versatile. It can be used in stews, stir fry and soup.

Supporting Literature

Lean pork has been found to be as satiating as other meats (beef and chicken) (Charlton KE et al., 2011). It's a rich source of protein, vitamins and minerals, delivering nutrients like thiamine, niacin and zinc. Choosing lean meat helps people adhere to experts' guidelines for health, including saturated fat intake.

The 2016 SADHS found that 68 per cent of women and 31 per cent of men in the country are overweight or obese. About 20 per cent of women and three per cent of men are severely obese (Demographic and Health Survey 2016). Unhealthy diets and lifestyles are among the main risk factors for the development of chronic non-communicable diseases. The risk starts in childhood and builds up throughout life. All these risk factors can be modified to help people live healthier lifestyles. Poor diet, as defined by a cluster of dietary risks, is the leading cause of death and is the first or second biggest contributor to non-communicable (NCD) disease burden in all six World Health Organization (WHO) regions. Of these dietary risks, the biggest contributors to the global burden of disease in 2017 were diets that are low in whole grains, high in sodium, or low in fruits, nuts and seeds, or vegetables. Additionally, there is an effect of higher body mass index on disease outcomes (WHO 2010).

Leading international experts and professional health organisations recommend increased consumption of plant-based food, such as vegetables and fruit, legumes, nuts, seeds and whole grains and locally produced, home prepared foods (Willet et al., 2019; WHO 2018).

Eating plenty of vegetables and fruit regularly can help prevent chronic diseases, including heart disease, high blood pressure, strokes, some types of cancer, aging related eye diseases and type-2 diabetes. These foods are also high in fibre (roughage), which ensures proper bowel functioning and helps to prevent constipation and related symptoms like bloating. Vegetables and fruit are not only

tasty and refreshing, but also provide colour and texture to meals. The WHO recommends that you should eat more than five portions (400 grams) of vegetables and fruit combined per day (NDH, 2019).

Home cooked stews and soups are excellent ways to increase vegetable and legume intake. Lean pork stew, stir fry and soup recipes are readily available. Combine the lean fresh pork with lots of in season vegetables and legumes for affordable healthy meals.

Tenderloin and leg cuts are commonly diced and used in casseroles and stews as they provide lean, well-textured meat which retains its shape during cooking. Make pork stew with cuts from the shoulder. Pork can be used in stew as well and has a relatively mild flavour compared to other red meats. The best cuts include those around the shoulder (North Valley Internal Medicine, 2023).

Fact 21

Pork meat is a healthy and the most affordable red meat in South Africa.

Supporting Literature

With discussions on food inflation, hunger and nutrition insecurity at all-time highs, low-income families are challenged to keep nutritious meals on the table. This is a tremendous and concerning problem that impacts the most vulnerable in our communities.

Poinsot & Maillot (2021) did a modelling study to explore the place of fresh pork among protein foods in the revised USDA Thrifty Food Plan (TFP) 2021. The USDA Thrifty Food Plan (TFP) is an estimate of a lowest-cost healthy diet that meets dietary guidelines while respecting existing eating habits. In the US, the TFP provides the basis for federal food assistance. The study shows that fresh pork is a high-quality, nutrient dense protein that fits into the lowest-cost healthy diet, meeting all the nutrient requirements and dietary guidelines. The research revealed that pork can fit into a nutritious diet at a lower cost. Selecting pork as the only source of meat protein in the TFP reduced the weekly cost below the current TFP cost levels and selecting pork as the only source of protein still allowed for nutrient-adequate diets in the TFP. Pork plays a critical role in addressing food inflation, hunger and nutrition security. This research supports this high-quality, affordable protein that not only feeds but also nourishes people around the world. (Poinsot & Maillot, 2021).

In South Africa given pork's relative affordability, which remains appealing, the industry ought to be able to contribute meaningfully to food security. This would require the product to appeal to a broader

range of consumers, making it critical to understand consumer preferences, with respect to both economic and non-economic factors (Bureau for Food and Agricultural Policy (BFAP), 2021).

Pork has previously been considered as inferior, however, that perception is changing especially in black communities. Consumers are consuming more pork as it is a cheaper alternative to other meat types. In the last five (5) years, measured in terms of carcass prices, pork sold for about 45% less than that beef and approximately 65% less than mutton. BFAP (2020) projected significant growth in this space in the coming decade, albeit slower than the past given pressure on consumer spending power (Bureau for Food and Agricultural Policy (BFAP), 2021).

Fact 22

Humans do not get the common flu or cold by eating pork meat.

Supporting Literature

Flu (influenza) is an infection of the nose, throat and lungs, which are part of the respiratory system. Influenza is commonly called the flu. Seasonal influenza is an acute respiratory infection caused by influenza viruses which circulate in all parts of the world. It represents a year-round disease burden. It causes illnesses that range in severity and sometimes lead to hospitalization and death (WHO, 2023).

Flu is contagious, which means it can be spread easily from person to person. Viruses that cause influenza spread from person to person mainly by droplets of respiratory fluids that are sent through the air when someone infected with the virus coughs or sneezes. Other people inhale the airborne virus and can become infected. The flu virus can also be spread when someone touches a surface (e.g., doorknobs, countertops, telephones) that has the virus on it and then touches his or her nose, mouth, or eyes. The flu is most easily spread in crowded places such as schools and offices (MediResource Inc, 2023).

There are four types of influenza viruses: A, B, C, and D. Influenza A and B viruses cause seasonal epidemics of disease in people (CDC, 2023). Influenza A viruses are the only influenza viruses known to cause flu pandemics (i.e., global epidemics of flu disease). Influenza C virus infections generally cause mild illness and are not thought to cause human epidemics. Influenza D viruses primarily affect cattle with spill over to other animals but are not known to infect people to cause illness (CDC, 2023). These viruses are divided into many subtypes. E.g. Influenza A viruses are divided into subtypes based on two proteins on the surface of the virus: hemagglutinin (H) and neuraminidase (N). There are 18 different hemagglutinin subtypes and 11 different neuraminidase subtypes (H1 through H18 and N1

through N11, respectively). More than 130 influenza A subtype combinations have been identified in nature (CDC, 2023).

Pigs can be infected with their own influenza virus that is different from human flu viruses. According to the World Organization for Animal Health Swine influenza viruses spread very rarely in human populations.

"Swine influenza is a highly contagious viral infection of pigs. The disease usually spreads very quickly within swine units (although all infected pigs might not demonstrate clinical signs of infection), and is followed by a rapid recovery of the infected animals. Swine influenza is not an OIE-listed disease. Swine influenza is caused by influenza A viruses, which are further characterised by subtypes namely H1N1, H1N2 and H3N2. Swine influenza is common in North and South America, Europe, and parts of Asia. It has been reported in Africa as well. Human infections with swine influenza viruses are occasionally reported, usually in persons who have direct contact with infected pigs and resembling seasonal influenza. Swine influenza viruses spread very rarely in human populations. The joint OIE-FAO network of expertise on influenza (OFFLU) comprises swine influenza experts from different regions of the world for global monitoring and characterisation of emerging viruses, the outputs of which are rapidly shared amongst the international community" (World Organization of Animal Health, 2023).

While rare, influenza can spread from pigs to people if people are in close contact with live infected animals. However, it is important to know that you cannot get Influenza A from eating properly handled and cooked pork or pork products (Michigan State University, 2016).

The US Department of Agriculture also confirms this. H1N1, formerly known as swine flu viruses, are not transmitted by food. You cannot get H1N1 from eating pork or pork products. Eating properly handled and cooked pork and pork products is safe. Cook all raw pork steaks, chops, and roasts to a minimum internal temperature of 62.8°C as measured with a food thermometer before removing meat from the heat source. For safety and quality, allow meat to rest for at least three minutes before carving or consuming. Ground pork should be cooked to 71°C. For reasons of personal preference, consumers may choose to cook meat to higher temperatures (US Department of Agriculture, 2022).

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