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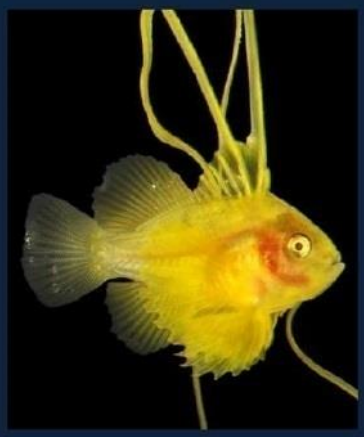

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Pork Production and Consumption: A Review of Global Patterns and Influencing Factors

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Abstract: The objective of this paper is to review the current status of pork production and consumption, as well as the various factors affecting them in different areas. Pig farming primarily produces pork, one of the most preferred meats worldwide. Pork, an edible post-mortem component obtained from pigs, is highly valued for its excellent meat yield, with dressing percentages ranging from 65-80%, higher than most other livestock species. It is a nutritious meat, rich in fat and energy, and contains essential vitamins such as thiamin, niacin, and riboflavin. Pork provides 15-20% high-quality protein on a fresh basis and supplies all essential amino acids, including lysine and methionine. Its energy value largely depends on its fat content, and it also serves as a good source of several important minerals. The increasing demand for pork in developing countries is associated with pigs' rapid fat deposition and the availability of diverse pork products such as bacon and sausages. However, several factors influence pork production and quality. These include short- and long-term stress, age, feeding systems, methods of stunning, aging, and chilling. In addition, cultural and religious beliefs significantly affect pork consumption patterns. In certain communities, particularly among Orthodox Christians and Muslims, the consumption of pork is prohibited due to perceptions that pigs are unclean animals, having cloven hooves and not chewing the cud. Furthermore, pork can be associated with zoonotic diseases such as tapeworm infections, which also contribute to consumer hesitancy in some regions. Therefore, this review aims to present the current status of pork production and consumption globally and regionally, identify the biological, cultural, and environmental factors affecting pork quality and demand, and propose potential mechanisms and strategies to address these challenges for the sustainable development of the pork sector.

Keywords: Meat consumption patterns, Global food security, Swine industry, Socio-economic influences

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Introduction

The global human population is expected to increase from 7.2 to 9.6 billion by 2050, driving a corresponding rise in demand for food, including meat products (Rojas-Downing *et al.*, 2017). World meat consumption is projected to grow significantly over the next 30–50 years as dietary

preferences expand with income growth. Pig farming–raising and breeding domestic pigs–is a major contributor to global food supplies because pork provides high-quality protein to human diets, and pork products such as bacon, ham, sausage, and gammon are widely consumed worldwide (Vicente and Pereira, 2024).

Pigs are adaptable to diverse climatic conditions, which has led to a large number of breeds distributed across the globe. Pork is considered one of the most nutritious meats in the human diet, valued for its protein content and versatility in culinary use (Silva Siqueira *et al.*, 2018). Consumer preferences for pork have shifted over time, with many now valuing meat quality attributes such as color, taste, and texture as much as quantity (Kim *et al.*, 2016).

Pork meat quality is determined by several factors, including water-holding capacity, pH, color, tenderness, marbling, firmness, aroma, texture, and chemical composition. These quality traits are influenced by breed and genetics, sex, pre-slaughter handling and stress, slaughtering and processing methods, and storage conditions (Tomović *et al.*, 2014). For example, the rate and extent of post-mortem pH decline strongly affect meat color and its ability to retain water–important drivers of consumer acceptance (pH, color, marbling, and water-holding capacity) (Rosenvold *et al.*, 2003). Pork may be prepared from fresh meat or processed (cured) into products like ham and bacon, typically using salt and other curing agents to enhance flavor and preservation (fresh pork carcass products are utilized in roasting and other forms of cooking) (Lebret and Čandek-Potokar, 2022).

Globally, pork is not only important for domestic consumption but also for international trade. China remains the largest producer and consumer of pork, accounting for over half of global pork production, though imports have fluctuated due to changing domestic supply conditions and trade policies. Major global exporters of pork include the European Union, the United States, and Canada, which supply both fresh and processed pork products to international markets (Moeller and León Crespo, 2009).

This review aims to summarize the current global status of pork production and to critically discuss the major factors influencing pork consumption in different regions, focusing on meat quality attributes, cultural preferences, and market trends.

Insights to the Literature

Global Condition of Pig and Pork

Pigs belong to the order Artiodactyla, an even-toed ungulate mammal, and the family Suidae, which includes non-ruminant, even-toed, hoofed mammals (Moeller and León Crespo, 2009). The genus of swine is Sus, which includes domestic pigs and the European wild boar. Pigs are domesticated animals; they have a simple, monogastric stomach and feed on both forage and concentrated or grain feed. Pigs serve as a source of food throughout the world and can adapt to and spread across different environments (Moeller and León Crespo, 2009).

The most commonly recognized breeds used in modern swine production units include Berkshire, Chester White, Duroc, Hampshire, Pietrain, Poland China, Landrace, Meishan, Spot, and Yorkshire (Large White). The most important challenges in pig production encompass improvement of nutrition (due to high feed costs), genetics and breeding, housing, health maintenance and disease prevention, handling facilities and techniques, training of stock-keepers, and environmental protection (Cheng, 2011).

Pork has played a major role in human diets for thousands of years, and its production and consumption are closely related to the development of agricultural production culture. More than 300 million tons of meat are produced worldwide, a large part of which is pork–about 110 million tons, or 37% of all meat consumed globally–followed by chicken (104 mmt) and beef (67 mmt)(FAO, 2013; OECD and FAO, 2014).

Table 1: Meat amount and percentages consumed in the world (Source: FAO, 2013)

Meat	Meat Consumed, 2012 (mmt)	Percentage of Meat (%)
Pork	110.8	37.4
Poultry	104.5	35.3
Bovine	66.8	22
Ovine	13.9	4.7
Total Common Meats	**296.0**	**100%**

Pork production depends on the potential for producing sufficient quantities of animal feed, primarily corn, as well as climate and religious restrictions. Most pork is produced in Asia (57.4%), followed by Europe (23.6%) and the Americas (17.4%), while production in Oceania and Africa is negligible. The world's largest pork producers are China (51%), the United States of America (10%), and Germany (4%). Countries with smaller contributions include Brazil (3%), Russia (3%), Vietnam and Canada (2% each), and Mexico, the Philippines, and Japan (1% each), while all other countries account for approximately 6% of global pork production (Table 1) (OECD and FAO, 2014).

China is not among the countries with the highest growth rates in pork production. In 2015, Argentina, the Russian Federation, and Belarus were estimated to have the highest growth rates, with slightly lower but still significant growth expected in other regions. The price of pork has increased over the last ten years due to rising feed costs, which have more than doubled. A particularly significant increase in feed prices occurred in 2012 as a result of decreased grain production. Pork demand is expected to continue rising due to growing consumption in countries with increasing incomes, population growth, and higher urbanization rates (OECD and FAO, 2014). Global pork production and consumption continue to rise (FAO, 2024).

Types of Pork Production Systems

There are three types of swine production systems based on the amount of capital, labor, and land available, the level of management and marketing skill needed, and social and environmental implications associated with manure management, like farrow-to-finish, farrow-to-feeder, and feeder-to-finish. To determine the best enterprise, the following should be considered (Plain and Lawrence, 2003).

Farrow-to-finish

A farrow-to-finish production involves breeding and farrowing sows, and feeding the offspring until they reach a market weight of about 280 pounds. The entire production period takes approximately 10 months, with 4 months for breeding and gestation and 6 months to raise the litter to market weight. Of the three systems, farrow-to-finish has the greatest long-run market potential and flexibility (Plain and Lawrence, 2003).

Farrow-to-feeder

A farrow-to-feeder production involves breeding and farrowing sows and then selling the piglets to finishing operations when they weigh 30 to 60 pounds. Compared to a farrow-to-finish operation, this option decreases the need for facilities, operating capital, and the amount of feed and manure handled. It also provides a good foundation for increasing the number of sows or

expanding into a farrow-to-finish operation (Plain and Lawrence, 2003).

Feeder-to-finish

Feeder-to-finish production buys feeder pigs weighing 30 to 60 pounds and feeds them to market weight. This system allows for minimum overhead, low labor requirements, and no long-term commitment. The feeder-to-finish operation offers an opportunity for a grain farmer to use homegrown feeds to finish pigs without having to manage breeding stock. The operation may capitalize on the fertilizer value of the manure. Important points of concern are the source, health, and quality of purchased feeder pigs. Ideally, all feeder pigs should originate from a single farm to reduce potential herd health problems (Plain and Lawrence, 2003).

There is another pig production system, like indoor and outdoor system. Outdoor system in a positive light by showing green pastures, sunshine, and spacious fields (FAO, 2013). Outdoor pigs experience cold and snow, rain and mud, heat, and extreme weather. Outdoor pigs can easily experience internal and external parasites. Indoor system in a positive light by showing sanitized pens, groups of clean, healthy pigs fed nutritious diets. However, some indoor units can be dirty, dark, and have high ammonia and unhealthy pigs. Stress hormone levels, health, mortality, and other production measures, on average, do not differ between indoor and outdoor-reared pigs (von Borell *et al.*, 2007).

Current Pork Consumption

Pigs are the most widely eaten animals in the world, accounting for about 38% of meat production worldwide. Consumption varies widely from place to place, and the meat is taboo to eat in the Middle East and most of the Muslim world because of Jewish kosher and Islamic Halal dietary restrictions. However, pork is widely consumed in East and Southeast Asia, Europe, Sub-Saharan Africa, the Americas, and Oceania, and as a result, a large number of pork recipes have been developed globally (Vicente and Pereira, 2024).

Types of pork product (*cuts*)

Pork should be cut before retail into shops by a butcher. Primal cuts of pork include pork loin, shoulder, pork tenderloin, pork crown, rib, and pork side, and these cuts differ in tenderness, fat content, and culinary applications (Vicente and Pereira, 2024). Fresh pork includes several main cuts. The pork loin supplies the largest number of fresh cuts and is the leanest, with meat that is tender and flavorful. The loin is divided into three parts: blade loin, nearest the shoulder; center loin; and sirloin, nearest the leg. Cuts from either end are not as tender as the center loin, making the center loin the most expensive (Vicente and Pereira, 2024).

Cuts from the upper portion of the shoulder, called the blade shoulder, are well marbled with fat and contain a lot of connective tissue, making them suitable for slow-cooking methods like braising, stewing, or barbecuing. Cuts from the arm, or picnic shoulder, are slightly more economical but otherwise similar. From the pork side, the only fresh cut is spareribs, which are very fatty and are best roasted, broiled, or braised (Vicente and Pereira, 2024).

Cured or processed pork includes products such as bacon, ham, sausage, terrines, galantines, and pâtés, which are derived from fresh meat and processed to enhance flavor and shelf life. Bacon comes from pork belly, which is cured and smoked, sometimes with injected flavor, and is high in fat and sodium. True ham is pork leg that has been cured, either by wet (brine) or dry methods, and sometimes smoked; the curing process affects texture, flavor, and shelf life. Sausages are made from chopped or ground pork and may be sold in casings or bulk. They are classified into four types: fresh, semi-dry, dry, and cooked, which differ in moisture content, texture, and preservation characteristics (Lebret and Čandek-Potokar, 2022).

Quality characteristics of pork

Pork quality is the measurable entirety of character traits, nature, or quality grade of a product or service. Thus, quality traits distinguish one product from other products either by their merits or deficiencies. The term pork quality concerns both the meat as a product (product quality) and the way the meat was produced (production quality). Further, product quality can be divided into technological, nutritional, hygienic, and sensory quality (Heyer, 2004). Technological meat quality includes the functional meat quality traits such as pH, internal and surface reflectance, water-holding capacity, chemical composition, and texture, measured as shear force (Poulsen *et al*., 2003).

The pH value of pig meat is also commonly influenced by several interacting factors, such as breed, gender, physical activity, and stress, all of which affect postmortem metabolism. In the postmortem muscle, the supply of oxygen is stopped, and consequently, ATP must be regenerated by an anaerobic glycolytic breakdown of glycogen. The accumulation product of lactic acid contributes to acidification and thus to decreased pH in the muscle. Water-holding capacity (WHC) describes the ability of meat to hold water during storage or processing (Poulsen *et al*., 2003).

Chemical composition of the meat in terms of water, protein, non-protein nitrogen, fat, carbohydrates, and inorganic constituents may be affected along the way from farm to fork. Proteins operate in the living animal as structural or contractile proteins, as hormones, enzymes, antibodies, and transport and osmotic proteins. In domestic vegetable feedstuff, the amino acid pattern of the protein is suboptimal and limited; lysine, methionine/cysteine, threonine, and tryptophan should be added to optimize the diet (menke and Huss, 1987). Pork quality is a critical part of most niche pork markets. The quality of pork is the result of a combination of genetic and environmental factors. There are four major criteria used in measuring pork quality: color, marbling, water-holding capacity, and ultimate pH (Poulsen *et al*., 2003; Świątkiewicz *et al*., 2021).

Pork quality criteria and measurement

The most common measurements used in determining pork quality are color, water-holding capacity, firmness, and marbling (Lucy, 2016).

Color: Pork color can be described as pale, red, or dark. Color is important because it impacts consumers' first impressions of the meat. Generally, a darker pink pork color is preferable. The minimum is a bright reddish pink (3.0 on the scale shown), although some markets prefer slightly darker (4.0–5.0).

Pork Color Scale: 1.0 Pale pinkish gray to white; 2.0 Grayish pink; 3.0 Reddish pink; 4.0 Dark, reddish pink; 5.0 Purplish pink; 6.0 Dark purplish red (Lucy, 2016).

Intramuscular fat or marbling: The fat within the muscle of pork is called marbling or intramuscular fat. It is the fat that provides much of the flavor in pork. Target level for nutrition, flavor, and health is 2–4 per cent. Marbling is recognized as a primary technological and sensory trait influencing eating quality and consumer perception (Rosenvold andAndersen, 2003).

Tenderness: Tenderness is important to consumer pleasure derived from eating meat. Tenderness is associated with the size of muscle fibers and the amount of connective tissue, and is influenced by factors such as ultimate pH and post-mortem proteolytic activity (Miller *et al.*, 2020).

Flavor and aroma: Meat flavor is influenced by chemical composition and post-mortem biochemical changes. Sensory attributes of pork can be affected by the presence of compounds such as androstenone and skatole, which are responsible for undesirable odors (boar taint) when present at high levels in fat from entire male pigs (Aluwé *et al.*, 2013).

Water-holding capacity or drip loss: The amount of moisture in pork that is lost when it is cut is called water-holding capacity or drip loss. Loss often increases when color is pale or pH is low. Lower values indicate less loss, which is preferable.

Muscles with low water-holding capacity are driertasting and lose more water during processing, storage, and transport, resulting in a less pleasing visual appearance, and are influenced by the rate of post-mortem pH decline (Rosenvold and Andersen, 2003).

Ultimate pH: The acidity of pork measured 24 hours after slaughter is called ultimate pH. It is a predictor of drip loss. A higher pH indicates better water-holding capacity and generally better eating quality. A target range of pH 5.6–5.9 for pork has been set by industry guidelines. Post-mortem pH is closely correlated with water-holding capacity, color, and tenderness (Rosenvold and Andersen, 2003).

Hygienic measurement: Bacterial load and pathogenic germs are important for assessing overall meat quality and food safety. Maintaining hygienic practices throughout the production chain, from producer to consumer, is essential to prevent contamination and ensure high meat quality (Pandey *et al*., 2024).

Nutrient Content of Pork

Pork is the meat of the domestic pig. It is the most commonly consumed red meat worldwide and, with fat trimmed, is leaner than the meat of most domesticated animals, but it is high in cholesterol and saturated fat (Vicente and Pereira, 2024). It is often eaten unprocessed, but cured pork products are also very common (Atli, 2019). Pork is a high-protein food and contains varying amounts of fat; it fulfills all essential nutrient requirements. Pork has high protein and is rich in many vitamins and minerals; lean pork can be an excellent addition to a healthy diet. Pork contains all nine essential amino acids that are available for body growth and maintenance, and it is beneficial for bodybuilders, recovering athletes, people post-surgery, or others who need to build up or repair muscles (Vicente and Pereira, 2024).

Pork is a source of key nutrients. Pork is an excellent source of high-quality protein, B-complex vitamins, and essential minerals such as zinc and iron, which play crucial roles in energy metabolism and immune function, and pork also contains significant amounts of phosphorus, selenium, and vitamin B6 (Vicente and Pereira, 2024).

Heart-Healthy:

Pork contains nutrients that can help regulate blood pressure, such as potassium, and some lean cuts meet criteria for heart-healthy foods, indicating lower fat and saturated fat levels in comparison to other red meats. Pork also contains bioactive compounds such as creatine, taurine, and glutathione, and such compounds have been studied for potential benefits in muscle and metabolic health when consumed as part of a balanced diet (Vicente and Pereira, 2024).

Health benefits of pork

Maintenance of muscle mass: Pork is essential to developing and building muscle mass because it provides high-quality protein. This makes pork effective for growth and maintenance of muscle mass, and improving muscle function and exercise performance, which has been supported in clinical dietary research comparing pork consumption with other protein sources (Murphy *et al*., 2014). Consumption of pork has also been linked in some studies to no harmful effects on cardiovascular risk factors when consumed as lean pork within a balanced diet (Vicente and Pereira, 2024). Pork and other products from pigs are relatively low-priced commodities, and because pigs can consume food waste and by-products, pork production can make use of industrial raw materials economically (Atli, 2019).

Adverse effects of pork

High consumption of overcooked pork may be associated with an increased risk of certain cancers and other chronic conditions, particularly when processed pork is included in the diet as part of red and processed meat consumption patterns linked to non-communicable diseases (Vicente and Pereira, 2024). The pork tapeworm (*Taenia solium*), the parasitic roundworms *Trichinella spiralis*, and *Toxoplasma gondii* are recognized meat-borne parasites that pose a

public health risk from raw or undercooked pork; cooking, freezing, and curing can inactivate many parasites, but good production and inspection practices are essential to prevent exposure (Gamble, 1997; Djurković Djaković *et al.*, 2013). *Taenia solium* infection (taeniasis) arises from consumption of undercooked pork containing cysticerci; *Trichinella* infection (trichinellosis) occurs similarly, and *Toxoplasma gondii* can infect humans via consumption of infected pork tissues(25, 26).

Hepatitis A virus infection can lead to acute illness (fever, fatigue, jaundice, vomiting, joint pain, and stomach pain), enlarged liver, and, in severe cases, liver failure and death. Infection can also lead to myocarditis, acute pancreatitis, neurological problems (such as Guillain-Barré syndrome), blood disorders, and elevated creatine phosphokinase, indicating muscle damage, and multi-joint pain when associated with foodborne viral exposure, including through contaminated meats or poor hygiene (Vicente and Pereira, 2024).

Factors Affecting Pork Quality

Pork quality is mainly affected by pre-slaughter and post-slaughter handling. Pre-slaughter factors that affect pork quality include the measurement of muscle pH, color, firmness, marbling, intramuscular fat content, shelf life, and cooked pork palatability. There are three basic pork quality defects associated with abnormal postmortem pH decline: pale, soft, and exudative (PSE) pork; dark, firm, and dry (DFD) pork; and red, soft, and exudative (RSE) pork (Rosenvold and Andersen, 2003).

The quality of pork is determined by many factors, including genetics, nutrition, handling, and processing. Genetics influence meat quality traits such as pH decline and water-holding capacity; for example, the halothane (Hal) gene and the rendement napole (RN) gene affect post-mortem muscle glycolysis, with the Hal gene being linked to increased PSE incidence and the RN gene to extended pH decline and reduced water-holding capacity (Salas and Mingala, 2017). Feeding regime and genotype also interact with pre-slaughter handling to influence muscle glycogen stores and ultimately pork technological quality (Rosenvold and Andersen, 2003).

Pork quality is influenced by genetic and environmental factors. Some environmental factors occur on-farm, while others occur at the processing plant. Stress genes such as the halothane gene are known to affect carcass muscle metabolism, leading to leaner, heavier muscled pigs that are more prone to PSE characteristics when exposed to stress before slaughter (Salas and Mingala, 2017).

Handling and stress: the stress of sorting, loading, and hauling pigs can have negative effects on pork quality, and poor handling practices are associated with muscle acidification abnormalities and meat quality defects such as PSE and DFD (Faucitano, 2018).

In general, pre-slaughter handling includes breed, genotype, feeding, stunning, and slaughter method. Transport stress caused by transport can result in pig fatigue, injury, poor meat quality, and ultimately death. Factors during transport that may compromise pig welfare include loading and unloading, journey duration, ambient temperature, placement on the transporter, stocking density, vibrations, floor type and bedding, mixing animals from different groups, and food and water deprivation, all of which are well documented as having adverse effects on meat quality outcomes when combined with stress responses (Faucitano, 2018).

Lairage: during this stage, mixing unfamiliar pigs, pen size, stocking density, floor type, and lairage temperatures and humidities can result in additional stress leading to skin damage and poor meat quality (Faucitano, 2018).

Other factors that affect pork quality

Gender Androstenone: Androstenone reaches a significant level in the fat of entire male pigs because it is primarily synthesized in the testes. Female and castratedpigs, therefore, usually have

an extremely low or undetectable level of androstenone. The level of androstenone in fat from entire male pigs generally ranges from 0 to 2.5 mg/kg and also depends on weight, stage of maturity, and genotype(29). Skatole can be present at significant levels in all genders because skatole is produced through hind-gut fermentation of the amino acid tryptophan and absorbed by the large intestine, a process that occurs in all genders (Zamaraskaia and Squires, 2008).

Genotype: Androstenone content in fat can be relatively easily changed through genetic selection, as concentrations of both androstenone and skatole are moderately heritable and can be influenced by breed and genetic background (Bidanel *et al*.,2014).

Age and Live Weight: The main effect of age and live weight on androstenone concentration is due to the sexual development that accompanies them. Various studies have demonstrated that androstenone levels in fat increase with age. The level of skatole in fat has also been shown to increase with age in all genders, likely linked to changes in hormonal status and microbial metabolism in older animals (Zamaraskaia and Squires, 2008).

Environment: There appear to be environmental factors that affect androstenone and skatole levels in the fat of pigs, including season, social interaction, and housing. Seasonal variations indicate that skatole concentrations tend to be higher in summer compared to winter, potentially due to differences in gut microbial activity and management conditions, although results on androstenone levels vary across studies (Oliveira *et al.*, 2022).

Nutrition: The effect of nutrition on the level of skatole in fat is influenced by dietary factors such as indigestible fiber level, protein level and type, and feeding regime. Dietary fiber may affect skatole concentration in fat by providing a readily fermentable energy source for hindgut bacteria, increasing microbial fermentation of tryptophan and potentially increasing skatole production, although the exact mechanisms vary with diet composition (Vigors *et al.*, 2008).

Stunning Chamber and Methods: A series of stunning methods have been described, including electric stunning and CO_2 stunning, which can affect stress responses and meat quality traits in pork, as pre-slaughter stress can influence biochemical processes related to pH decline and boar taint compounds (Faucitano, 2018). Storage condition, chilling, and pork aging also affect pork quality through their impacts on muscle biochemistry, water-holding capacity, and protein degradation (Faucitano, 2018).

Factors Affecting Pork Consumption

Nutritional and toxic factors of pork

Consumption of freshly cooked pork products causes acute responses, such as inflammations of the appendix and gall bladder, biliary colics, acute intestinal catarrh, gastroenteritis with typhoid and paratyphoid symptoms, as well as acute eczema, carbuncles, sudoriparous abscesses, and others. These symptoms can be observed after consuming sausage meats, including salami, which contains pieces of bacon in the form of fat (Reckeweg, 1983).

Fat is always associated with cholesterol. Cholesterol is responsible for the formation of large cholesterol-loaded molecules in the blood, which contribute to high blood pressure and arteriosclerosis, as well as being supplementary factors in cardiac infarctions and disorders of the coronary circulation, and in the peripheral blood vessels, especially in combination with nicotine in smokers. Cholesterol is also found in the walls of cancer cells (O'Connor *et al.*, 2017).

Sulfur-rich substances of the connective tissue, the mucopolysaccharides (amino-sugars, chondroitin sulfates, hexosamine, glucosamine, etc.), have a specific mucous character. It is only possible with pork to produce a sausage that is easy to spread, where amino sugars, hexosamine, and sulfur derivatives such as chondroitins, sulfuric acid, and mucoitin sulfuric acid found in

pork are directly responsible for this reaction. They cause a mucous swelling of the connective tissue and then combine with fat for storage. From this develops a characteristic swelling reaction, which is peculiar to pork eaters. The connective tissue furthermore acts like a sponge and causes the typical cushion-like dilation of connective tissue. The storing of these mucous substances in sinews, ligaments, cartilages, and other tissues can be dangerous and can result in rheumatism, arthritis, arthroses, and damage to intervertebral discs, among other conditions (Reckeweg, 1983).

Pork is rich in growth hormone, which is generally regarded as the prime cause of inflammation and swollen tissues. Consumption of pork is also attributed, to some extent, tohaving some effect on acromegaly, or pathological protrusion of the chin and other prominent skeletal parts of the body, in particular adiposity, as well as an increased general tendency toward abnormal growth. This is particularly true in the growing trend toward cancer, where damaged tissues from earlier toxic (possibly chemotherapeutic) treatment are concerned. Cancer is associated with smoked bacon, as smoked bacon is a carcinogenic substance (Reckeweg, 1983).

There are skin-irritating effects from the histamine content in pork. These irritations are often accompanied by inflammatory processes such as boils and carbuncles; inflammation of the appendix; gall bladder disorders; inflamed veins; leucorrhea in women; abscesses; and phlegmons. Histamine can also be responsible for skin diseases such as nettle rash, eczema, dermatitis, neurodermatitis, and other dermatoses. Chronic cases of urticaria (nettle rash) have been observed in elderly female patients and among young children (Moore and Knight, 2015).

Another very important toxic factor in pork is the influenza virus, which remains infectious in the lungs of pigs. As pork is used in sausage, hot dogs, and similar products, this organism is often present, transmitting the flu virus through consumption. These organisms then migrate to their biological origin, which in this case is the connective tissue of the lungs. There they remain dormant until factors of propagation are advantageous, as in spring, when there are shortages of vitamins, lack of sunshine, and the onslaught of influenza epidemics. Although these epidemics may appear to be airborne in origin, they may in reality be partly due to virus absorbed through pork consumption (World Organisation for Animal Health, 2025).

Cultural factors and buying behavior on pork consumption

Cultural, social, personal, and psychological factors are the four major influences on consumers' buying behavior regarding pork. These factors also cause consumers to develop product and brand preferences (Rani, 2014). Cultural values include perceptions, wants, and behaviors that a person learns continuously in a society (Schiffman and Kanuk, 2010).

Religious factors on pork consumption

Pork consumption is prohibited in certain religions. It is forbidden by both Christians and Muslims (Akpan and Sunday, 2016). Apart from religious reasons, pork consumption is also reduced due to its perceived adverse effects. Studies indicate that religious restrictions on pork consumption are partly attributed to the fact that pigs' bodies contain many toxins, worms, and latent diseases in larger proportions than are found in other animals. One reason for this is that pigs scavenge and will eat any kind of food, including dead insects, worms, rotting carcasses, excreta, garbage, and other pigs. Humans are also said to contract influenza (flu) from pigs (Li and Wang, 2021).

Strategies for Reducing Stress and Maintaining Pork Quality

Spend time with pigs prior to sorting day; this will reduce the pigs' fear of humans. Be patient and quiet, move slowly, and keep pigs in a group, as isolation stresses pigs. Pigs follow other pigs. Work pigs early in the morning, particularly during hot weather. In hot weather, sprinkle pigs

during transit. Take pigs off feed, but not water, about 12 h before slaughter (Faucitano *et al.*, 2007).

Conclusion

Global pork production is geographically concentrated, yet consumption is deeply fragmented by cultural and religious norms, creating distinct market realities. The quality of pork, crucial for consumer acceptance, is not fixed but is determined by a cumulative sequence of genetic, managerial, and processing factors, where poor welfare practices directly undermine product value. Nutritionally, pork presents a duality, being a rich source of essential nutrients while also being associated with health concerns tied to fat content, processing, and zoonotic diseases, creating a significant perception challenge. Ultimately, the most substantial barriers to consumption are non-market forces, including religious prohibitions and culturally embedded aversions, which are often compounded by legitimate food safety fears. For producers, implementing integrated low-stress handling protocols from farm to slaughter is essential to safeguard welfare and meat quality, while developing certified, value-added products (e.g., welfare-assured, specific feeding) can capture niche markets. Policymakers must strengthen food safety inspection systems and public education on safe handling to address zoonotic risks, while supporting sustainable intensification through incentives for better management practices. Researchers should prioritize applied studies on practical welfare interventions that also enhance meat quality and conduct nuanced consumer science to understand socio-cultural drivers, enabling targeted strategies that bridge the gap between production and diverse consumer expectations.

Ethical Statement

No animal or microbes have been used or sacrificed for this study, hence Ethical Approval not required.

Author Contributions

Each author has contributed equally to the study's planning, analysis, writing, and editing. All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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