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HEALTH-PROMOTING PROPERTIES OF POULTRY MEAT IN THE CONTEXT OF DISEASES OF CIVILIZATION

PROZDROWOTNE WŁAŚCIWOŚCI MIĘSA DROBIOWEGO W ASPEKTCIE CHOROÓB CYWILIZACYJNYCH

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Streszczenie. Dla współczesnego konsumenta coraz większe znaczenie mają wartość odżywcza i walory prozdrowotne spożywanej żywności. Wynika to z większej świadomości ludzi dotyczącej związku odżywiania się z występowaniem niektórych chorób cywilizacyjnych. Spożywanie mięsa i jego przetworów ze względu na właściwości odżywcze i funkcjonalne może mieć związek z występowaniem chorób cywilizacyjnych. Na uwagę zasługuje mięso drobiowe, które jest cenione przez konsumentów przede wszystkim dzięki swoim unikatowym właściwościom. Stanowi ono doskonałe źródło łatwo przyswajalnego i pełnowartościowego białka o wysokiej wartości odżywczej. W porównaniu z innymi gatunkami mięsa mięso drobiowe jest lekkostrawne i mniej tykowane po poddaniu obróbce termicznej, gdyż zawiera mniej włókien kolagenowych. Dzięki mniejszej ilości tłuszczu śródmięśniowego cechuje się mniejszą kalorycznością. Może być stosowane w diecie małych dzieci, kobiet ciężarnych i osób starszych, dla których może stanowić ważne źródło białka i dobrze przyswajalnego tłuszczu. Ponadto istnieją pewne dowody naukowe świadczące o jego prozdrowotnych właściwościach, do których zaliczyć można redukcję ryzyka nadwagi i otyłości, chorób układu sercowo-naczyniowego, cukrzycy typu 2, a także pewnych nowotworów występujących np. w jamie ustnej, przełyku czy żołądka.

Key words: poultry meat, diseases of civilization.

Słowa kluczowe: mięso drobiowe, choroby cywilizacyjne.

INTRODUCTION

The nutritional value and health-promoting properties of food are of increasing importance to the contemporary consumer. This is due to greater awareness of the link between diet and certain diseases of civilization. Hence bioactive products contributing to proper balance of the daily diet and compensating for nutritional deficiencies are highly valuable (Devcich et al. 2007). Consumption of meat and meat products, due to their nutritional and functional properties, can both cause and to some extent prevent diseases of civilization.

Poultry meat, valued by consumers for its unique properties, is worthy of attention. According to Goluch-Koniuszy et al. (2009), substantial intake of animal protein can be

conducive to acidification of the body, leading to leaching of calcium and magnesium ions from the bones and increasing their elimination with the urine, which may contribute to the development of osteomalacia and osteoporosis. Although according to some authors meat consumption should be restricted (Szostak 1995), mainly because it contains fats which are a source of cholesterol and saturated fatty acids (Kolanowski and Świdorski 1997; Bacers and Noll 1998), the high biological value of meat protein is an argument in favour of its inclusion in the human diet.

Meat from various poultry species plays a particularly important role in this respect, due to its lower content of fat, lower calorific value, higher digestibility and high dietary value. In Poland, broiler chickens and turkeys are the primary poultry meat, with their production increasing systematically over the last few years, while broiler ducks, geese and ostriches are niche products. In 2004 Poland produced over 1 200 000 tonnes of poultry meat, but in 2014 production increased to 2 200 000 tonnes (GUS 2014; The Poultry Market 2015). Per capita poultry meat consumption in the European Union in 2014 was about 22.2 kg. It is prognosticated that consumption will reach 22.4 kg in 2016, which indicates that poultry will account for about 30% of total meat consumption in EU countries (The Poultry Market 2015). The growth trend in poultry production is maintained at the expense of decreased demand for beef or pork meat and meat products.

One of the factors contributing to this situation is the difference in price. Poultry meat, particularly that of broiler chickens, is relatively inexpensive. This is due to such factors as the rapid growth rate of the birds, their short rearing period and their relatively small nutritional requirements in comparison with other slaughter animals. An additional factor contributing to the growing consumption of poultry meat is the fact that in comparison with the meat of other animals, meat from broiler chickens and turkeys has a unique chemical composition. It is an excellent source of easily assimilated complete protein with nutritional value surpassing that of pork or beef. The total content of this nutrient is higher while the amount of connective tissue and collagen is lower, so that poultry meat is less tough and fibrous and more easily digestible. Furthermore, poultry meat has lower calorific value because it contains less cholesterol and fat; moreover, the fat is easily removed as it is located under the skin and not intramuscularly as in the case of red meat. It is also a source of minerals such as iron, copper, calcium and potassium, and of fat-soluble vitamins E, A and D.

The objective of the study was to present the health-promoting properties of the meat of various poultry species in the context of diseases of civilization.

NUTRITIONAL VALUE OF POULTRY MEAT

The quality of poultry meat is largely dependent on long-term and short-term factors. Long-term factors include genotype, sex, age, diet, environmental conditions during the rearing of the birds, and their health condition. Short-term factors include handling of the birds from the completion of rearing to slaughter and how the meat is acquired (Kijowski 2000; Cierach and Niedźwiedz 2009). An important element indicating the quality of poultry meat is its nutritional value (Pomianowski et al. 2011), which varies among different species. A study by Kunachowicz et al. (2010) shows that turkey breast meat without the skin

contains just over half the fat (0.7 g/100g) of chicken breast (1.3 g/100g) and less cholesterol (49 mg/100g and 58 mg/100g). Similar relationships hold for thigh meat, which indicates that the meat of broiler turkeys is leaner than that of broiler chickens.

CALORIFIC VALUE

The dietary value of poultry meat is determined by several factors. In comparison with beef or pork it has low calorific value and low fat content, and high content of complete protein and other nutrients (Kijowski 2000; Wilkanowska 2013). The energy value of poultry meat depends on the cut; for example, thigh meat has more calories than breast meat, and the energy value is higher for meat with skin than without it (Kunachowicz et al. 2012). Due to its higher fat content, the calorific value of meat with skin has been shown to be about 25–30% higher. The calorific value of poultry meat is also affected by the type of heat treatment. Boiling increases the calorific value of meat with skin by about 25–30% (mainly due to the loss of water during this process) – Lofgren (2005).

PROTEIN

Protein content in poultry meat ranges from 18% to 25% (Ślaska-Grzywna et al. 2013). The proportion of protein depends on the amount of water and fat in the product. Boiling causes an increase in the concentration of this nutrient. Depending on the meat cut, protein can account for as much as 60% of the weight of a turkey or chicken leg (without skin) (Marangoni et al. 2015).

Protein of poultry meat, like that of other animal products, is called complete protein due to the presence of all essential amino acids in the proper proportions (Ciborowska and Rudnicka 2014). Ensuring suitable intake of complete protein in the diet maintains the body's intellectual and immune function (Cichosz and Czczot 2013). Moreover, the protein present in poultry meat is highly digestible – up to about 97%. For comparison, the digestibility of protein contained in plant products ranges from 70% to 80% (Ślaska-Grzywna et al. 2013). The biological value of this nutrient is not reduced by cooking (Wilkanowska 2013). Another beneficial characteristic of poultry meat is the low content of collagen in the muscles, which can decrease the product's digestibility (Marangoni et al. 2015). An excessive level of this incomplete protein in the connective tissue of the muscles affects the tenderness of the meat, decreasing its quality and making it tough and fibrous (Janicki and Buzala 2013).

FAT

The nutritional value of poultry meat largely depends on the content and quality of fat in individual cuts. Fat content is up to 1.5% in the breast muscles of young gallinaceous poultry and 4.5% in the thigh muscles. Heat treatment (boiling) may increase the fat concentration in a product by removing water from the meat. It is particularly worth noting that fats from poultry meat are more easily assimilated than fats from the meat of other animal species. The fat tissue in poultry meat is evenly distributed, but a substantial portion of it is accumulated under the skin rather than between the muscles, so that it is easier to remove than in the case of red meat (Ślaska-Grzywna et al. 2013; Wilkanowska 2013; Marangoni et al. 2015).

In terms of nutrition, the composition of poultry fat is beneficial. It contains considerable amounts of unsaturated fatty acids (UFA), and in comparison with the meat of other animal species, substantial quantities of polyunsaturated fatty acids (PUFA – polyunsaturated fatty acids), particularly of the omega-6 family, such as linoleic acid – LA (18 : 2 Ω -6) and arachidonic acid – AA (20 : 4 Ω -6), which are most often present in the skin (Hibbeln et al. 2006). The human body is not able to synthesize omega-3 and omega-6 PUFA (e.g. α -linolenic acid – ALA), so they must be supplied in the diet. Because birds consume feed of plant origin, which contains mainly unsaturated fatty acids, poultry meat also provides its consumers with a certain amount of this class of fats. In most western countries, where consumption of fish (the main source of omega-3 fatty acids) is relatively low, poultry meat can be an important source of these fatty acids in the diet (Givens and Gibbs 2008; Wilkanowska 2013).

PUFA are recommended in the treatment and prevention of cancers, obesity, arteriosclerosis, hypertension, and diabetes. PUFA deficiencies in the diet lead to a reduction in the level of docosahexaenoic acid (DHA – docosahexaenoic acid), which is a component of brain and retinal cells and of sperm, determining their normal physiology. A suitable amount of DHA in the diet of pregnant women and new-borns may ensure the development of the central nervous system in infants and young children (Achremowicz and Szary-Sworst 2005; Wilkanowska 2013).

Poultry fat has a highly beneficial ratio of polyunsaturated to monounsaturated fatty acids: 0.8. Moreover, the total content of fatty acids is a factor increasing the tenderness of the meat structure and making it less fibrous (Wilkanowska 2013).

Further evidence of the health-promoting value of poultry meat is its lower cholesterol content than in the case of other animal species (Wilkanowska 2013). Excessive cholesterol in the blood serum is a very important risk factor for cardiovascular disease and arteriosclerosis (Brunzell et al. 2008).

VITAMINS AND MINERALS

Poultry meat is a significant source of valuable minerals and vitamins in the human diet. It contains iron, zinc, copper, selenium, potassium, magnesium, chlorine, calcium, phosphorus and manganese. Furthermore, poultry meat is an excellent source of B vitamins (thiamine, niacin, riboflavin and cobalamin), as well as the fat-soluble vitamins A, D and E (Ślaska-Grzywna et al. 2013; Wilkanowska 2013).

POULTRY MEAT CONSUMPTION AND HUMAN HEALTH

Diverse epidemiological studies carried out in many parts of the world among populations with varied food preferences and habits have confirmed the relationships between diet and human health. Several prospective studies have demonstrated that consumption of poultry meat in a balanced diet decreases the risk of cardiovascular disease and reduces potential risk factors for insulin resistance, cancer, and overweight or obesity (Marangoni et al. 2015).

PREVENTION OF OVERWEIGHT AND OBESITY

Research analysing the effect of high- and low-protein diets on body weight has found that patients consuming meals with higher protein content lost weight more rapidly (Halton and Hu 2004). Within a short time period (up to about 6 months), a high-protein and low-energy diet was found to lead to a greater loss of body weight than a diet with the reverse proportions of these nutrients. This phenomenon may be due to increased satiety, which suppresses the appetite, reduces the desire for food intake and enables normalization of the lipid profile and the concentration of glucose and insulin. Elevated protein metabolism leads to an increase in thermogenesis, which may have an additional appetite-suppressant effect, as well as increasing the metabolic rate (Nazarewicz 2007; Paoli 2014).

The results of other studies indicate that when fat intake in the diet does not exceed 30%, an increase in the amount of protein does not significantly contribute to a reduction in body weight (Farnsworth et al. 2003). Comparison of the effect of reducing diets differing in amounts of protein and carbohydrates showed that the reduction in the amount of lipid tissue and in body weight was independent of these nutrients (Layman et al. 2003; Noakes et al. 2005).

CARDIOVASCULAR DISEASE

Proper diet is of great importance in the prevention of cardiovascular disease, particularly ischaemic heart disease (Kłosiewicz-Latoszek 2009; Kwaśniewska 2011). According to recommendations by the American Heart Association, prophylactic measures should aim to achieve and maintain health-promoting dietary habits. The goal is to maintain a healthy body weight and to achieve appropriate plasma concentrations of total cholesterol and lipoproteins and healthy blood pressure (Krauss et al. 2000). The effect of protein on the occurrence of cardiovascular disease depends on its source (Hu 2005).

A study conducted in the United States on a population of women found that higher consumption of red meat and dairy products with high fat content was linked to a significantly higher risk of cardiovascular disease than consumption of poultry, fish and low-fat dairy products. Substituting one daily portion of red meat with one portion of poultry may decrease the risk of cardiovascular disease by 19% (13% if the red meat is replaced by low-fat dairy products and 24% if it is replaced with fish) (Hu et al. 1999; Hu 2005; Feskens et al. 2013). The possible mechanisms linking consumption of different meats with coronary disease are determined by the chemical composition of the meat. In red meat, the content of saturated fatty acids (SFA – saturated fatty acids), cholesterol and iron is considerably higher than in white meat. SFA are perceived as the main risk factors for cardiovascular disorders (hypercholesterolemia, hypertension, arteriosclerosis, or ischaemic heart disease) as well as for insulin resistance and type 2 diabetes (Kłosiewicz-Latoszek 2009; Abete et al. 2014).

TYPE 2 DIABETES

A change in lifestyle including modification of the quantity and quality of saturated fats consumed can decrease the risk of type 2 diabetes (Kłosiewicz-Latoszek 2009; Cichosz and Czczot 2013). Research has found that hyperinsulinemia and insulin resistance are linked

to consumption of saturated fats of animal origin (Pan et al. 2011; Feskens et al. 2013). An EPIC (European Prospective Investigation into Cancer and Nutrition) – InterAct study conducted on a group of over 340.000 adults from eight European countries showed that the prevalence of type 2 diabetes was higher in patients whose diet included more animal protein, particularly in women whose BMI was over 30. Nevertheless, detailed data on poultry consumption have confirmed that there is no statistically significant relationship between increasing weekly consumption of chicken and turkey meat and the development of the disease (Feskens et al. 2013; Van Nielen et al. 2014).

A dietary standard based on a high level of poultry consumption in combination with whole-grain products, fish, fruit and vegetables, accompanied by reduced intake of red meat, processed foods, starches and simple sugars, seems to be effective in treating type 2 diabetes. The results of an EPIC study also indicate that a healthy lifestyle and poultry consumption in combination with increased intake of fruit, vegetables, pulses, nuts and vegetable oils is correlated with a reduced risk of death in a population of patients with type 2 diabetes. These observations confirm that in these patients substantial benefits can be obtained by a change in lifestyle involving the introduction of white meat in suitable proportions (Aune et al. 2009; Pan et al. 2011; Lee et al. 2013).

CANCER

Epidemiological research conducted in a population with high or very high intake of animal products has shown that excessive meat consumption is a potential risk factor for cancer (Kushi et al. 2012; Zur Hausen 2012). Possible factors affecting the development of cancer include iron, sodium, N-nitroso compounds and aromatic heterocyclic compounds generated during cooking of meat at high temperatures (frying or grilling), as well as saturated fatty acids (Turesky 2007). Excessive consumption of red meat is believed to be linked to a greater risk of cancer than in the case of increased white meat in the diet. This is probably due to differences resulting from the chemical composition of the two types of meat. In comparison to red meat, white meat has a somewhat lower content of potentially carcinogenic components (such as unsaturated fatty acids; the correct proportion of these acids in the diet is important because excessive supply of omega-6 and omega-9 fatty acids is linked to increased risk of cancer, e.g. of the breasts, intestines and prostate, while omega-3 acids exhibit anti-tumour activity (Majewska 2015). For this reason it is considered to be a meat with a neutral effect on neoplasia or even to have chemoprotective properties (Bingham 1999; Migdał 2007; Turesky 2007).

According to a report by the World Cancer Research Fund, individuals consuming animal products should increase the amount of poultry and fish in their diet while reducing intake of red meat, which should not exceed 300 g of cooked meat per week. Moreover, consumption of processed foods should be maximally reduced and not exceed 500 g/week (equivalent to about 750 g of raw meat) – World Cancer Research Fund (2007).

Among all cancers, those affecting the digestive tract are linked to consumption of animal products. Observations have shown that these cancers are much more prevalent in populations whose level of meat consumption exceeds recommendations. It has been hypothesized that myoglobin from red meat induces precancerous changes via catalytic

breakdown of haem from iron, which contributes to the production of carcinogenic N-nitroso compounds and to the development of cytotoxic and genotoxic aldehydes (Bastide 2011).

It has thus far been demonstrated that due to its unique properties, consumption of white meat (fish and poultry) may have a prophylactic role in decreasing the risk of certain cancers (Table 1).

Table 1. The effect of meat consumption on the incidence of cancer in selected human organs
Tabela 1. Wpływ spożycia mięsa na występowanie zmian nowotworowych w wybranych narządach człowieka

Site of tumour Miejsce występowania nowotworu	Effect of meat consumption on neoplastic processes Wpływ spożycia mięsa na procesy nowotworzenia	Source Źródło
Mouth and throat Jama ustna i gardło	The risk of morbidity is increased for individuals regularly consuming processed meat (on average 3–6 portions/ week) than in those consuming other kinds of meat – Wzrost ryzyka zachorowalności u konsumentów, regularnie spożywających przetworzone mięso (średnio 3–6 porcji na tydzień), w odniesieniu do spożywających inne jego rodzaje	Bosetti et al. (2000)
Oesophagus Przełyk	Consumption of turkey and chicken reduces the risk of cancer, with the best effects observed in patients whose consumption of the meat of these birds was highest – Spożywanie mięsa z indyka i kurczaka powoduje zmniejszenie ryzyka rozwoju zmian nowotworowych, przy czym najlepsze efekty uzyskali pacjenci, u których odnotowano większe spożycie mięsa tych ptaków A high level of poultry consumption is linked to an approx. 53% reduction in the risk of cancer – Wysoki poziom spożycia drobiu jest związany z redukcją ryzyka wystąpienia zmian nowotworowych o około 53% The protective effect depends on the individual's nutritional status, quality of life and lifestyle – Efekt ochronny jest zależny od stanu odżywienia pacjenta, jakości i stylu życia, które są na ogół lepsze u osób, które preferują mięso drobiowe	Bosetti et al. (2000); Flood et al. (2008); Zhu et al. (2014)
Stomach Żołądek	The risk of cancer in the stomach is inversely proportional to the level of consumption of vegetables, fruits, vegetable oils and poultry, which exert a protective effect on the mucosa – Ryzyko wystąpienia zmian nowotworowych w obrębie żołądka jest odwrotnie proporcjonalne do wysokiego spożycia warzyw, owoców, olejów roślinnych i drobiu, które wywierają działanie ochronne na śluzówkę	Ji et al. (1998)
Colon and anus Jelito grube i odby	There is no definitive evidence confirming the chemoprotective effect of white meat on the risk of colon cancer, but it is suggested that high intake of processed red meat containing preservatives can increase the risk of cancer Brakuje jednoznacznych dowodów potwierdzających chemoprotekcyjny wpływ mięsa białego na ryzyko wystąpienia nowotworu jelita grubego, ale sugeruje się, że wysoka podaż czerwonego mięsa konserwowanego wykazuje właściwości kancerogenne	Key et al. (2004)
Breasts Piersi	The effect of poultry meat on the incidence of breast cancer has not been definitively confirmed – Nie potwierdzono jednoznacznie wpływu mięsa drobiowego na występowanie raka piersi Replacing one portion of red meat with a portion of white meat may reduce the risk of breast cancer by about 17% in all women and by 24% in post-menopausal women – Stwierdzono, że zastąpienie jednej porcji mięsa czerwonego jedną porcją mięsa białego może zmniejszyć ryzyko wystąpienia raka sutka o około 17% u wszystkich kobiet oraz o 24% u kobiet w wieku pomenopauzalnym	Männistö et al. (2005); Farvid et al. (2014)
Ovary Jajnik	No link has been found between consumption of meat (especially meat fat) and the incidence of ovarian cancer – Brakuje związku między spożyciem mięsa (zwłaszcza jego tłuszczu), a także innych składników odżywczych na wystąpienie raka jajnika	Schulz et al. (2007); Kolahdooz et al. (2010)
Liver Wątroba	The mechanism is not fully known. An inversely proportional relationship has been demonstrated between white meat consumption and the incidence of liver cancer – Mechanizm nie został dokładnie poznany. Wykazano odwrotnie proporcjonalny związek między spożyciem białego mięsa a występowaniem raka wątroby	Freedman et al. (2010)

CONCLUSIONS

There is currently some scientific evidence confirming the beneficial and protective effect of the meat of broiler chickens and turkeys on human health. In most cases analysed the exact mechanisms of action have not been fully explained. Nevertheless, due to their unique properties, these products should be an integral component of the human diet. Analyses conducted by some authors indicate that replacing red meat with alternative protein sources such as poultry may be a successful strategy for reducing the risk of overweight and obesity, cardiovascular disease, type 2 diabetes, and certain cancers, e.g. of the mouth, oesophagus, or stomach. Due to their digestibility and low collagen content in the muscle tissue, poultry meat can be included in the diet of young children, pregnant women and elderly individuals, for whom it will be a valuable source of protein and easily assimilated fat.

The effectiveness of including poultry meat in the diet appears to depend on the age group observed, the health condition of the subjects, and the climate zone they inhabit, as well as other dietary factors and the size of the daily portion of poultry products. Additional difficulties are associated with the fact that poultry meat may be modified to improve its sensory properties, e.g. by the introduction of various amounts of vegetable oils in the diet of the birds, which causes changes in the fatty acid profile in the muscles.

Given the arguments cited, poultry meat should be an integral component of a well-balanced diet.

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Abstract. The nutritional value and health-promoting properties of food are of increasing importance to the contemporary consumer. This is due to greater awareness of the link between diet and certain diseases of civilization. Consumption of meat and meat products, due to their nutritional and functional properties, can both cause and to some extent prevent diseases of civilization. Poultry meat, valued by consumers for its unique properties, is worthy of attention. It is an excellent source of easily assimilated, complete protein of high nutritional value. In

comparison with other kinds of meat, poultry meat is easy to digest and less tough after cooking, because it contains fewer collagenous fibres. It also has fewer calories due to its low content of intramuscular fat. Poultry meat can be included in the diet of small children, pregnant women and elderly individuals, serving as an important source of protein and easily assimilated fat. Moreover, there is some evidence that its health-promoting properties may include reducing the risk of overweight and obesity, cardiovascular disease, type 2 diabetes, and certain cancers, e.g. of the mouth, oesophagus or stomach.