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NUTRITIONAL, DIETARY AND HYGIENIC CHARACTERISTICS OF EGGS: PATHOGENETIC SUBSTANTIATION OF THEIR USE IN MEDICAL NUTRITION

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Abstract: The article presents data characterizing the specific nutritional feasibility of using chicken and quail eggs in human nutrition as a source of essential amino acids, vitamins, macro- and microelements, and other nutrients that determine their dietary properties. The article emphasizes the importance of cholesterol, lecithin, choline, lysozyme, lutein and zeaxanthin.

Keywords: chicken eggs, quail eggs, protein, yolk, nutritional value, biological value, protein, fat, amino acids, vitamins, micro- and macro elements, ovomucoid, cholesterol, lecithin, choline, lysozyme, digestibility, gastric ulcer, duodenal ulcer, hyperacid gastritis, biliary dyskinesia, sanitary benignity, epidemic safety.

Eggs are a traditional food for different segments of the population around the world. This is due to the high biological and nutritional value of eggs. At the same time, there are certain restrictions on egg consumption based on the specifics of their composition and properties. Eggs are widely used in food both in their natural form and in dishes. People in Ukraine consume mostly chicken eggs, but also duck, goose, turkey and quail eggs. Because of their composition, eggs are an extremely valuable product. The peculiarity of the egg structure, which consists of white and yolk,

justifies their different chemical composition and thus different nutritional and biological value. The same feature allows the egg to be divided into separate parts and used for their intended purpose, which is especially important in medical and dietary nutrition.

Poultry eggs (chickens, quail, ducks, geese, turkeys) do not differ significantly in structure, nutritional and biological value. Eggs are a source of protein (13 g per 100 g) of high biological value (amino acid number 1.0), contain fats balanced in fatty acid composition, water- and fat-soluble vitamins, macro- and microelements, as well as biologically valuable substances such as lecithin, choline and lysozyme and various enzymes (protease, dipeptidase, diastase).

Egg white is considered the international standard for protein quality because it contains all the essential amino acids in an optimal ratio. The most important egg proteins in nutrition are ovalbumin, as well as ovoglobulin, which provides foaming when whipping proteins, ovomucin, which helps stabilize this foam, and lysozyme, which has an antibacterial effect. Yolk proteins are represented by phosphoproteins.

Egg proteins are balanced in terms of all essential amino acids and are therefore an international benchmark for assessing the quality of protein in various products. The main proteins of the egg white are ovalbumin (54%) and conalbumin (12-13%), which mainly provide nutritional and biological value. Ovoglobulins (2%) include two types, G1 and G2, and ensure the ability of egg whites to form foam while whipping; ovomucin (1.5-3.5%) is a highly viscous glycoprotein, that stabilizes this foam. Lysozyme (3.4-3.5%) is a bacteriostatic factor in eggs that inhibits the development of microflora in eggs for 7-10 days. Avidin extracted from raw eggs is an antivitamin factor that forms an inactive biotin-avidin complex that is not absorbed in the intestine and leads to biotin deficiency.

The main protein in the yolk is vitelline, rich in phosphoproteins. The digestibility of egg proteins is high - 98%, while egg proteins after heat treatment are more digestible than raw proteins.

Egg fats are found in the yolk and are mainly represented by triglycerides and phospholipids. Low melting point and emulsification of egg fats contribute to their

easy digestion and good digestibility of up to 96%. The fatty acid spectrum of egg lipids is dominated by palmitic acid out of saturated fatty acids, oleic acid out of monounsaturated fatty acids and linoleic acid out of polyunsaturated fatty acids. Around 1/3 of egg fat is composed of biologically active phospholipids. The main part of phospholipids is lecithin, which contains a vitamin-like substance, choline.

Eggs are a particularly cholesterol-rich food. The daily recommended intake of cholesterol for healthy adults is 2 to 2.5 eggs, which is why eggs (yolks) are restricted in case of atherosclerosis and other diseases. However, it should be borne in mind that egg cholesterol is favorably balanced with anti-atherogenic nutrients such as lecithin, linoleic acid and vitamins.

The egg yolk contains cholesterol (570 mg per 100 g), therefore egg yolks are traditionally limited in the diets of the elderly and patients at risk of developing atherosclerosis.

Eggs are a source of water- and fat-soluble vitamins. Vitamins A, D, B₂, B₁₂ and the vitamin-like substance choline contained in 100 g of eggs meet the daily requirement of an adult by more than 20%. The majority of fat-soluble vitamins and the vast majority of water-soluble vitamins (except for riboflavin) are found in the yolk.

Egg yolk is an important source of blood-forming trace elements (iron - 6.7 mg, copper - 139 mcg, cobalt - 23 mcg, zinc - 3.1 mg per 100 g), which makes it advisable to use it in the diet of children from six months of age with artificial feeding and from seven months of age with breastfeeding and mixed feeding. One fifth of the yolk of a hard-boiled chicken egg is added to mashed vegetables or porridge. [1, p. 317].

Raw egg albumin contains anti-nutritional factors. While consuming raw eggs, the avidin protein, as an antivitamin factor, actively binds biotin (vitamin H) into a biologically inactive avidin-biotin complex. One molecule of avidin binds three molecules of biotin, so frequent consumption of raw eggs can lead to hypovitaminosis H. Dermatitis caused by hypovitaminosis H occurs in children with approximately 30% of the daily energy value of the diet covered by raw eggs. The

avidin-biotin complex is water insoluble, not subject to enzymatic breakdown and is not absorbed in the intestine, but it is inactivated when eggs are heated to 80⁰ C. In addition to avidin, raw egg albumin has two other anti-alimentary factors: protein trypsin inhibitor and conalbumin. Protein trypsin inhibitor is an ovomucoid by chemical nature. The mechanism of antialimentary action is reduced to the formation of relatively stable enzyme-inhibiting complexes that cause a decrease in the activity of proteolytic enzymes of the pancreas - trypsin, chymotrypsin and elastase, as a result of which dietary proteins are not fully digested and absorbed. Heat treatment of eggs inhibits this specific effect. Conalbumin binds iron, so only the yolk is used to enrich children's diets with iron [2, p. 439].

Chicken eggs are widely used in healthy (rational) diets in all age groups within the global food system. They contain choline, folate, vitamin D, iodine, B vitamins and high quality protein and are no longer considered a risk factor for hypercholesterolemia and cardiovascular disease. Furthermore, they are recommended for use in weight control programs as well as for increasing protein metabolism. In several randomized controlled trials, eggs have been shown to increase muscle protein synthesis and reduce fat mass, allowing for optimal body composition.

It should be noted that the balance of evidence indicates that eggs are a nutritious food, suggesting that there are major health benefits to be gained from including eggs in the diet in amounts higher than those currently consumed by the European population. Over the past two decades, specific recommendations to limit egg consumption to about three per week have been abolished by health authorities in the UK and the US. Nutritional guidelines in many European countries now mention that eggs can replace meat and fish as a more sustainable source of protein. Some countries' recommendations do not set limits, there are no specific guidelines for consumption, but where the number of eggs is recommended, it varies from two or three per week in Finland and the Netherlands to seven eggs per week in Ireland and Bulgaria. In the Flemish region of Belgium, it is recommended to “eat no more than seven eggs a week, otherwise the risk of developing diabetes may increase.”

According to the WHO FAO, the adult population is recommended to consume 5-7 eggs per week (in the absence of individual restrictions). The rational egg consumption rate recommended by the WHO FAO is 295 eggs per year per person. Currently, the actual consumption in Ukraine is 189 pieces, which is only 2/3 of the recommended rate [3, p. 12].

Eggs are used in the diet as: a source of ideal complete protein, left-handed, sulfur-containing amino acids and labile SH-groups; a source of minerals: P, Cu, Co, Zn, Mn (yolk); K, Na, Cu (protein); source of vitamins A, D, E, B12, H, choline (yolk); B1, B12, H (protein); source of lipids: the main source of lecithin (yolk); SFA, PUFA.

According to the “Norms of consumption of the main food groups for breakfast, lunch or dinner in preschool education institutions in case of a five-day stay”, it is recommended to include in the diet of children from 1 to 7 years old boiled, fried with the addition of a minimum amount of fat, cooked until fully cooked, 1 egg twice a week during breakfast, lunch or dinner.

As part of a healthy diet, it is advisable to consume egg yolk and white in an optimal ratio of 1:4 and combine them with vegetables.

Medical and dietary nutrition uses exclusively dietary eggs - chicken eggs from epidemiologically safe farms, within seven days after laying.

Eggs cause little gastric secretion due to the fact that they do not contain extractive substances and can be used in medical and dietary nutrition as a source of complete protein.

Cooked protein moderately reduces the acid-forming function of the stomach, and is effective in inflammatory diseases of the gastrointestinal tract. Raw protein more actively reduces the acidity of gastric juice. Whole egg is recommended for gastric ulcer and duodenal ulcer, chronic gastroduodenitis with gastric hypersecretion.

Chicken eggs differ in terms of digestibility in the way they are eaten. Boiled or fried eggs are 90% (almost completely) absorbed by the human body, while raw yolk and protein are only 60-65%. The absorption of nutrients in eggs is better after

heat treatment than in raw eggs, since the temperature of 80⁰ C inactivates avidin and destroys the protein inhibitor trypsin. Soft-boiled eggs and steamed omelets (egg mass whipped in an optimal ratio) are best digested and absorbed. These dishes slightly stimulate gastric secretion and are prescribed for gastritis with increased secretion, gastric ulcer and duodenal ulcer [4, p. 204].

Egg white is used in therapeutic nutrition for diseases of the liver and gallbladder, intestines, gout and obesity. It is better to cook eggs in the form of an omelet for children, the elderly and the sick ones, because whipped and heat-treated egg mass is better digested and absorbed. Soft-boiled and chopped eggs are widely used in tube feeding as a source of complete, easily digestible protein. Eggs (egg yolk) are excluded from the diet of people with hypercholesterolemia and atherosclerosis. The ability to separate the yolk (which contains cholesterol) from the protein allows you to use egg (protein) dishes in hypocholesterol diets.

Hard-boiled eggs are prescribed for obesity because denatured protein has a greater specific dynamic effect. The egg albumin of a hard-boiled (10 minutes) chicken egg is an energy negative product, because more energy is spent on its breakdown and digestion than is provided by albumin. Eggs have inherent allergic properties, so their consumption can cause food allergies. The sensitizing effect of heat-treated eggs is less pronounced. In people prone to food allergies, yolk proteins (but mostly white) can cause allergic reactions. Hard-boiled eggs are less likely to have an allergic effect than raw or soft-boiled ones. However, the raw product is used in the treatment of diseases of patients suffering from pathological processes in the gastrointestinal tract - ulcers, gastritis with high acidity. This is due to the fact that egg white contains a trypsin inhibitor that prevents gastric mucosal irritation and inflammation.

Raw egg white is used to prepare oxygen foam, which is added to herbal decoctions and herbal compositions (sedative, choleric, etc.), as well as part of the complex therapy of relevant diseases and conditions, including those accompanied by hypoxia. Only dietary eggs should be used to make oxygenated foam. The shelf life of whipped foam with filler is 2 hours at a temperature not exceeding +4⁰ C.

Egg yolk, especially raw egg yolk, has distinct choleretic properties that are used in cholestasis and gallbladder tests, but it is precisely because of these features that egg yolk is limited in the diet of patients with cholecystitis and gallstone disease. In addition, yolk cholesterol can accelerate the formation of cholesterol concretions in case of gallbladder congestion and biliary tract infections. [5, p. 317].

Cholesterol is an essential construction element for cell membranes. In addition, it is necessary for the body to produce vitamin D and sex hormones, testosterone and estrogen. Endogenous cholesterol is produced by the liver and intestines in the required amount, exogenous cholesterol enters the body with food. One egg contains 212 mg of cholesterol, which is more than half of the recommended daily allowance (300 mg). However, it is still important to remember that eating eggs does not increase total blood cholesterol, because lecithin, which is also found in large quantities in eggs, reduces the adhesion of cholesterol to the intima of blood vessels. Eating eggs has a good effect on the amount of high-density lipoprotein. People who have higher levels of high-density lipoprotein (HDL) usually have lower risks of heart disease, atherosclerosis, stroke and other health problems. Therefore, eating eggs is a great way to increase HDL levels (a study by the Loegernes Center in Denmark shows that eating two eggs a day for six weeks increased HDL levels by 10%) [6, p. 418]. The yolk is a source of choline, which is used to construct cell membranes, plays an important role in the production of signaling molecules in the brain, regulates insulin levels, and has a hepatoprotective effect. Chicken eggs are good for pregnant women because choline has a positive effect on the fetal brain.

The yolk contains lutein and zeaxanthin, antioxidants that are beneficial for the eyes, counteract degenerative processes in the retina and, according to research, significantly reduce the risk of cataracts and macular degeneration, two very common eye disorders. According to a study by the French National Institute of Health and Natural Sciences, eating just 1.3 egg yolks a day for 4.5 weeks increases blood lutein levels by 28-50% and zeaxanthin by 114-142%. Eggs also have a high content of vitamin A, the lack of which is the most common cause of blindness in the world.

Beaten-up eggs (raw egg yolk mashed with sugar) improves the condition due

to retinol and lecithin, increases the surfactant activity of the alveolar epithelium and is prescribed for chronic nonspecific lung diseases. It should be remembered that eggs can provoke food intolerance or allergies, which is especially important for children with a predisposition or hereditary prerequisites for diathesis. Boiled eggs have a less significant sensitizing effect on the body than raw eggs. Raw eggs are contraindicated for people with pancreatitis, diabetes mellitus, and other diseases that disrupt protein metabolism in the body.

Quail eggs are high in nutrients (quail eggs contain 2 times more retinol, phospholipids and choline than chicken eggs (per 100 g of product)), and birds are less likely to suffer from infectious diseases than chickens. This makes the product relatively safe for fresh consumption. It is advisable to use boiled quail eggs in the diets of children with lung pathology. The indicators of sanitary quality of eggs depend on the impeccability of feed, which is due to environmental safety and technological methods of their cultivation. The sanitary quality of eggs is based on the control of priority egg contaminants, namely salts of heavy metals (lead, cadmium, arsenic, mercury, copper, zinc) and organochlorine pesticides. Safety indicators also include: tetracycline antibiotics, streptomycin, hormones (diethylstilbestrol) and aflatoxin B₁. Eggs can become a factor in the transmission of avian salmonellosis and thus pose a certain epidemic risk. Eating eggs can cause infectious diseases and food poisoning. Despite the system of mechanical and chemical protection of eggs, microorganisms can penetrate them endogenously or exogenously. Endogenous infection occurs as a result of microbes entering the egg during its formation in the ovary of a sick bird or during its passage through the oviduct. In this way, duck, goose and chicken eggs can become infected with *Salmonella*, *Mycobacterium tuberculosis*, *E. coli*, *Pseudomonas*, *Proteus*, *Staphylococcus*, etc. Duck and goose eggs are particularly dangerous in terms of salmonellosis in humans. The risk of salmonellosis after eating chicken eggs has increased due to the use of bone, meat and fish meal contaminated with microbes as additives to chicken feed. *Mycobacterium avium* contained in eggs from chickens with tuberculosis can cause disease in humans that is benign [7, p. 245].

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