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Formation and variesties of IgY Antibodies

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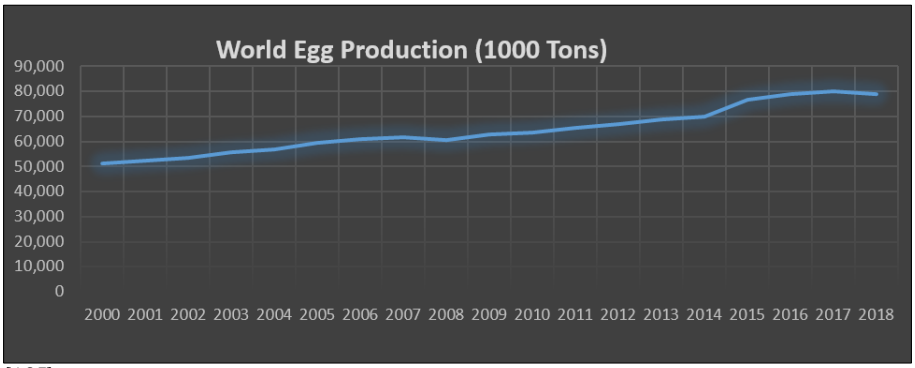
Abstract
The egg is one of the cheapest food sources for a balanced and healthy diet in terms of its rich protein fat, carbohydrate, vitamin, and mineral content. Especially in many studies, it is stated that the nutrient content of eggs can be considered equivalent to breast milk. This feature of the egg has also been observed to accelerate growth and development in babies and children. While the production and consumption of eggs throughout the world is increasing day by day; Its use has become widespread in many sectors. Especially in recent years, eggs are not just food; Their use in fields such as pharmacology, cosmology, and medicine draws attention. . In recent years, prevention of salmonella, dental caries and gum diseases, breast, ovarian, gastritis, ulcer, stomach cancer, etc. It is used in the treatment of diseases. It is also known to have properties such as toxin neutralization and anti-tumor activity. It is known that the immunoglobulin contained in the egg provides immunity for the hatching chicks for a long time. The immunoglobulin IgA, IgM, and IgY found in the egg are found in mammals; It shows very similar properties with IgG, IgA, IgM, IgD, and IgE. The most common production of monomer antibodies occurs in mammals and other animal species. Monomer antibody production creates an immunological response against factors that enter the human or animal body from outside and are especially pathogenic (bacteria, viruses, parasites, etc.). This ensures the production of antibodies against the specific desired antigen from poultry with the stimulation of the immune system. Genotypes to the IgY produced show significant variations between animal breed and species. The amount of IgY obtained from poultry eggs can vary from day to day. Among the reasons for this, it is due to environmental stress factors such as insufficient maintenance method, temperature, humidity. It is known that the total amount of IgY obtained is higher in genotypes with high egg yield and high egg yolk weight. Also, the amount of IgY obtained from poultry decreases with increasing age. However, its average annual production is much higher than experimental animals such as rabbits. It is especially noteworthy that there are no stress factors during the acquisition of IgY, and it is easy and economical. This study, it is aimed to give information about how IgY obtained from eggs is formed in the egg and its usage areas.

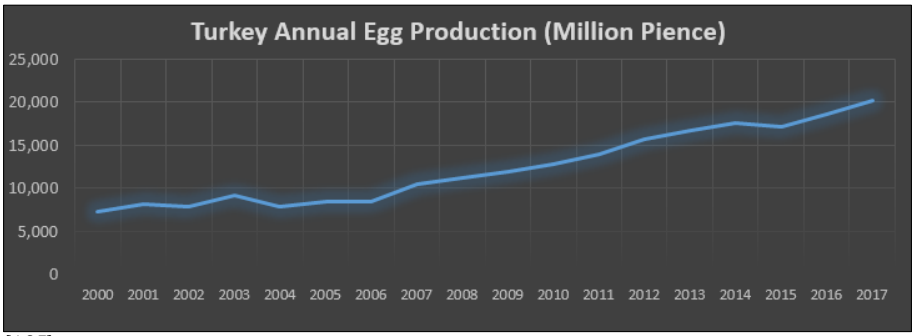
Keywords: Antibody, Antigen, IgY, Egg

Introduction
For a healthy and balanced diet, a sufficient amount of protein, fat, carbohydrate, vitamin, and mineral substance needs must be met. Animal products are at the top of the foods with all these features. Animal source products such as milk, eggs, and meat are consumed intensively due to their high nutrient content [1]. The meat and eggs obtained from poultry, are the cheapest products containing the basic nutritional needs of people [2]. Also, these products are heavily consumed due to their essential nutrients, high protein, and low-fat content [3]. Poultry egg production has increased significantly in the last 20 years due to developments in poultry breeding worldwide. When the developments in poultry farming in our country are examined chronologically, it is seen that product was made in small family businesses in the 1970s, and in the 1980s, due to the structural changes that occurred with the increase of industrialization, integrated facilities were established. Also, it is seen that the contracted production model has started to be implemented. With the government support and the personal efforts of entrepreneurs, the number of modern production facilities increased in the 1990s, however; production capacity has also been developed rapidly and high standard production has begun [2]. Also, high-efficiency lines have been obtained through various breeding studies in poultry breeding. In the years 1960-1980, an average of 225-273 eggs are obtained annually, while in 1990-2000, an average of 306-310 eggs is produced annually. It is also known that the average annual egg production of some lines varies between 320 and 350 [2].



[4,6,7]

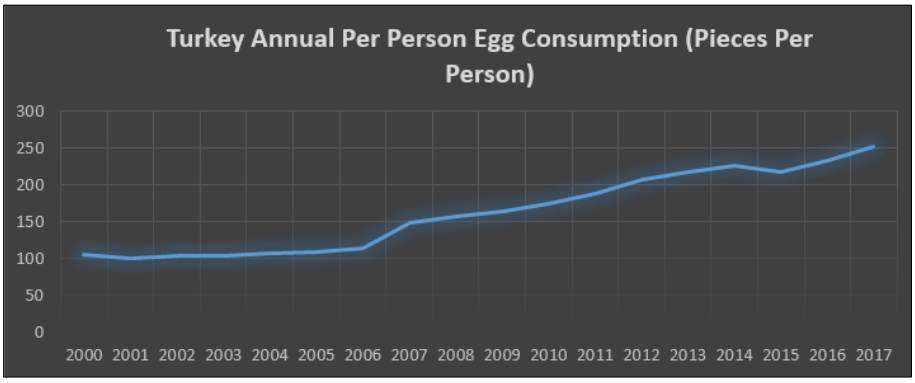
Fıg 1: World Egg Production Amounts According to Years



[4,6,7]

Fıg 2: Turkey's Egg Production Amount Realized ln The Year

When Table 2 is examined, the annual amount of eggs produced in the 2000s was 7.245 million tons, and in 2008 it exceeded 10.515 million tons. Following this, while an average of 15.677 million tons of eggs was produced in 2013; It is stated that 20,254 million tons of annual eggs were produced in 2017 [4,5,6]. In Turkey, together with the increase in the year of egg production has caused the world to take part in general in the first place [4]. When the egg consumption per capita in 2017 is analyzed worldwide, 333 in Japan, 307 in China, 305 in Russia, 277 in the United States, 230 in Germany, Turkey has reported being 192 and 252 in Brazil [4].



[4, 6,7]

Fıg 3: The Amount of Egg Consumption Compared To Turkey's Year

Table 3 clearly shows an increase in egg consumption Referring to Turkey in [4,6,7]. When we look at the whole world, it is observed that the egg has started to be used in many areas due to its rich content. Especially, its use in the field of health has gained importance in recent years [8,9]. The antibodies contained in the egg have similar characteristics to those produced in mammals. In the studies conducted, it was found that the egg has new bioactive compounds with antimicrobial, anticancer immunomodulator, and antioxidant properties [8, 9]. In addition to being a food only, the use of eggs in fields such as medicine, pharmacology, pathology, cosmetics, and chemistry has attracted attention recently [9,10]. One of the most important reasons for this is that immunoglobulins obtained from eggs are produced in larger quantities than experimental animals such as rabbits and mice, and they are cheap and easy [10]. The purpose of this study is to give information about how IgY obtained from eggs is formed in the egg and its usage areas.

The structural components of the Egg

Among animal foodstuffs, one of the valuable nutrients that can be compared with milk and meat due to their nutrients and high-quality protein content is eggs obtained from poultry animals. The egg is considered to be the most beneficial nutrient after breast milk. The eggs contain protein, carbohydrates, fat, vitamins, and various elements. Although the shape and size of eggs are very different in poultry species, their physical structures are similar. The egg; The shell consists of subshell membranes (inner and outer), albumin, and yellow. It consists of egg yolk (ovum), germinal disc, algebra, yellow material, and the vitelline membrane surrounding them. Yellow has a heterogeneous structure. Albumin (egg white) is also heterogeneous, consists of 4 layers. These layers are listed as outer watery white, outer thick white, inner watery white, and inner thick white (chalazion layer). Chicken eggs consist of 9-11% shell, 60-63% albumin, and 28-29% egg yolk [11]. The main composition of the shellless egg is water (75.8%), protein (12.9%), and lipids (9.9%) [12]. It contains small amounts of carbohydrates, vitamins, minerals, and some important bioactive components [13]. An average-sized egg contains about 6 grams of fat. Egg oils are rich in essential fatty acids and do not contain trans fats. Eggs contain oils that are mostly composed of saturated fatty acids. These oils are emulsions in egg yolk. The most important of the oils in eggs are lecithin and cholesterol. Also, there are vitamins B1, B2, and niacin, more than iron, calcium, sulfur, vitamins A and D. The biological value of egg protein is complete, an average sized egg contains about 6-13 g of protein [2]. Eggs have a very low carbon hydrate level, no fiber, and low energy content. The main composition of the eggshell is minerals. Proteins are nearly similar in the amount in white and yellow, with lipids found only in egg yolk [14]. 88% of egg whites is water and almost all of the rest consists of proteins. Egg white proteins are mainly in glycoprotein structure. The carbohydrate content of egg whites is low. Carbohydrates are mainly in the form of glucose and cause the Maillard reaction in their products. Lipids and cholesterol are almost absent in egg whites. 48% of egg yolk consists of water. It contains all of the egg lipids and about half the protein. It is rich in egg yolk, vitamins, and minerals. It is the cheapest and best quality animal product preferred due to its rich nutrient content [15].

Egg and nutrition relationship

Especially the fact that the egg is among the cheapest protein sources is one of the reasons why it is one of the indispensable food sources of child and baby nutrition [16]. In the nutrition of children and babies (for the age group 1-6), 1-2 grams of protein per kilogram per day is required. The one egg consumption per day contains all the nutrients necessary for healthy growth and development, such as proteins, carbohydrates, fats, vitamins, minerals, and water [15, 17]. For example, the average daily protein requirement of a person weighing 70 kg is 56–70 g [18,19]. Egg, which is the cheapest food to meet this need, also plays a role especially in child development [20]. It has been stated in many studies that growth and development for children are equivalent to mother's milk for a balanced and healthy diet [21]. It is also included in many products, such as many ready-to-eat formulas, as it supports infant development [17].

Antibodies (Immune Globulins, IgY)

When an antigen is administered or enters the body, it creates a unique immune response. These proteins in the structure of globulin are called "Immunoglobulin" or immunogenic, immunogenicity, which means "Immune globulin" since they take part in immune events in the defense of the body. İmmünglobulinleri kısaca “Ig” Clark gösterilmektedir. Antibodies in globulin (Ig) structure bind to antigens and cause them to dissolve, precipitate, neutralize, or aggregate. Thus, antibodies that are effectively prepared by the body protect the body against the entering antigen [22,23]. Antibodies are produced specifically by "Plasma cells". Plasma cells arise by differentiating from lymphocytes in many lymphoid tissues in the body. Immunoglobulins are molecules in the structure of glycoproteins that exhibit antibody activity and have the ability to specifically combine with antigens that cause them to form and cause reactions [23]. Immunoglobulins make up 20% of total plasma proteins. They are found in small amounts in tissues, intercellular fluids [24]. Blood or plasma coagulate, they are contained in the serum. A serum containing antibodies against a certain antigen is called "antiserum". Experiments based on searching for antibodies in serum are also called "serological tests" [25,26]. Immunoglobulins are mainly involved in the gamma globulin part of the electrophoresis of serum proteins [24]. Also, some beta globulin is collected in the alpha globulin part. Immunoglobulins are synthesized by plasma cells formed by the exchange of B-lymphocytes as a result of antigenic stimulation. When antibodies are examined chemically, physically, and immunologically, there are important differences between them. These differences are based on properties of antibody molecules such as carbohydrate amounts, electrophoresis rates, molecular weights, amino acid structures, and the type of H (= heavy) polypeptide chain they carry [27].

Immunoglobulins in mammals; It has five different properties: Immunoglobulin G (IgG), Immunoglobulin A (IgA), Immunoglobulin M (IgM), Immunoglobulin D (IgD), Immunoglobulin E (IgE). Immunoglobulins are in glycoprotein structure and are approximately 90% polypeptide and 10% carbohydrate. Immunoglobulins show a similar structure and constitute an Ig molecule from at least one basic unit, also called "monomer" [24,28]. IgG are the most abundant (70 - 75%) and smallest antibodies in the body, they are produced against bacteria and viruses and they provide passive immunity to the embryo by passing from the mother to the embryo via the placenta. The density of IgG in blood and tissues is equal. The form of IgG found in poultry is IgY and its structural form is very similar to each other [29]. Immunoglobulins in poultry; It has 3 different properties, including IgA, IgM, and IgY. IgY is the basic immunoglobulin in chickens and is abundant in the yolk [30]. IgA and IgM are concentrated in egg white [30].

Production of egg IgY antibodies

Antibody production in mammals is similar to antibody production in poultry and other animals. The most common monomer antibody production in mammals and other animal species. Monomer antibody production is an immunological response that enters the human or animal body from outside and occurs especially against pathogenic (bacteria, viruses, parasites, etc.) factors. Antibodies are injected (intramuscularly or subcutaneously) against a specific desired antigen from poultry [32]. Thus, it is produced with the immune system stimulation for the production of antibodies against the antigen in question. The antibodies produced are transferred from the blood to the egg yolk. Studies have shown that the weight of egg yolk and the amount of IgY produced are directly proportional [10]. Immunization must be repeated regularly to ensure the desired antibody production from poultry. The amount of IgY produced shows significant variation among genotypes, animal breed, and species. The

amount of IgY obtained from poultry eggs can vary from day to day [32]. Among the reasons for this, there are environmental stress factors such as insufficient maintenance methods, temperature, and humidity. It is known that the total amount of IgY obtained is higher in genotypes with high egg production and high egg yolk weight [33]. Also, the amount of IgY obtained from poultry decreases with increasing age [31]. In some studies, it is stated that a high amount of IgY can be obtained in advanced ages with diethylstilbestrol treatment [35]. The amount of IgY in eggs obtained from chickens can also vary from day to day [53]. When immunoglobulins in egg serum were examined, it was reported that IgA was 0.7 mg / mL, IgM was 0.15 mg / mL, and IgY was found to be the as a high rate of 25 mg / mL in egg yolk [31]. When the studies are examined, an average of 1.3 g per year from a rabbit While observing IgG production; It has been determined that a chicken can produce an average of 240-280 IgY per year (considering 100-150 mg of IgY in each yolk obtained), approximately 28-42 g [31]. This IgY produced is stable for a long time and can be stored for 5–10 years at 4 degrees without loss of antibody activity [36]. IgY production from egg yolk is both easy; as well as an economical choice. At the same time, taking blood, etc. Stress factors affecting animal welfare are almost nonexistent. Thus, the IgY quality obtained from egg yolk is higher [34,37]. Its advantages such as collecting eggs are noteworthy.

Some Studies

Yamamoto *et al*. (1975) [38] reported that a significant proportion of the IgA and IgM antibodies found in egg whites and IgG in the yolk were present in the yolk sac even before the last day of incubation [38, 39, 40]. Also, IgA or IgM are not transferred to the fetal circulation; instead, they are transferred to the embryonic intestine as part of the egg white [39,41]. Since the immune system of newly hatched chicks is not fully developed, they are susceptible to pathogens in the first two weeks. Antibodies transferred from chickens in eggs provide specific protection against antigens [42,43,44,45,46]. Lawrence *et al.* (1981) [47] stated that B cells that secrete IgY in the plasma of a hatched chick were not detected until day 6 after hatching [47]. While IgM synthesized endogenously was observed in 3 and 4 day old chicks; IgA antibodies have been observed in the plasma of 12-day-old chicks [48,49]. It is an indication that the antibody transferred from the chicken to the egg is used for a long time.

Use of produced Antibodies

Immunoglobulin is one of the basic antibodies produced in chickens. IgY is used as an alternative to antibiotics in various fields in medicine and veterinary medicine [34]. Immunotherapeutic applications of IgY: Oral intake of IgY is used in the prevention of Pseudomansaeruginosa infections in patients with cystic fibrosis and in the prevention and treatment of Helicobacter pylori infections that cause gastritis, ulcers, and stomach cancer. Also, it is used effectively in the prevention and treatment of dental caries and gum diseases, in the prevention of Salmonella infections caused by S. Enteritidis and S. Typhimurium, and in the prevention of infections in cattle and some livestock [34, 50]. IgY is used in the qualitative and quantitative diagnosis of many substances [50]. Especially in recent studies, it is used as a biomarker to detect and measure cancers (breast, ovarian, stomach cancer, etc.). It has anti-tumor activity [33]. It is effective in cancer treatment. It also has toxin neutralizing activity. It is used as a neutralizer against poisoning, snake, and scorpion bites [37,50]. It is also widely used in the Pharmacology, cosmetics, and chemical industry [51,52].

Results

The eggs obtained from poultry contain sufficient amounts of vitamins, minerals, fats, carbohydrates, and proteins for a healthy and balanced diet. This nutrient content of eggs has been stated in many studies to be equivalent to mother's milk. In particular, the fact that the egg is one of the cheapest animal protein sources is the essential nutrient required in infant, child, and adult nutrition. Together with the physical and chemical events that develop since the egg's formation, it creates a unique immune response within the egg. The immune response is involved in the immune events of these proteins, which are in the structure of globulin in the egg. In this task, Immunoglobulins can specifically combine with antigens that show antibody activity and cause them to form. Also, they are molecules in the structure of glycoproteins that can cause a reaction by plasma cells formed by B lymphocyte exchange as a result of antigenic stimulation and enable their synthesis. These events are very similar in mammals and poultry. The most common monomer antibody production in mammals is the body of humans and animals, IgG in mammals, and IgY in poultry as an immunological response against pathogenic factors (bacteria, viruses, parasites, etc.). This feature provides antigen production against the desired antibody in poultry. In this way, antibodies produced against the desired antigen are used as an alternative to antibiotics. It is also noteworthy that the amount of IgY obtained from poultry is higher than the other. At the same time, it is both easy and economical to obtain. Egg production and consumption have increased significantly over the years. Especially in recent years, eggs are used not only as a nutrient but also in fields such as pharmacology, cosmology, and medicine. In many studies, it is used as a biomarker, in the treatment of cancer (breast, ovarian, stomach cancer, etc.), toxin neutralization, various dental diseases, and many infections.

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