Study of Changes in Calciferol in Eggs in Depending on the Season of the Year

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Annotation

Determining the amount of vitamin D in everyday foods is important in the prevention, treatment of pathological conditions related to hypo- and avitaminosis, as well as in maintaining a healthy physiological level of health.

The aim of the study was to study the influence of the season of the year on changes in vitamin D in eggs.

As a biomaterial for the experiment, we used egg yolks of local domestic chickens and chickens of the so-called German breed, which were kept in the vivarium of the Central Scientific Research Laboratory under standard conditions.

The amount of vitamin D in the eggs of domestic hens is 11.89% higher in winter, 50.0% in spring and 44.0% higher in summer than in eggs of German breeds.

Keywords: *cholecalciferol, ergocalciferol, colorimetry, calcidiol.*

Relevance. The traditional role of vitamin D is to maintain the normal state of the musculoskeletal system. However, in recent years, evidence has been obtained that reduced serum concentrations of the hormonal form of vitamin D, 1,25-dihydroxyvitamin D, are associated with a number of non-skeletal diseases (certain types of carcinoma, arterial hypertension, age-related cognitive decline, dysfunctions of the immune and reproductive systems and etc.). These disorders can be avoided if the blood serum level of 1,25-dihydroxyvitamin D is much greater than what is required to maintain normal bone tissue, control absorption, and maintain calcium homeostasis [1].

As a result, identifying the amount of vitamin D in common foods is critical for preventing and treating pathological disorders associated with hypo- and avitaminosis, as well as maintaining a healthy physiological level of health.

Both cholecalciferol and ergocalciferol's principal purpose is to ensure calcium and phosphorus absorption in the small intestine (mainly in the duodenum). Vitamin D's importance for the human body is well understood, as it influences the formation of the skeletal system as well as several extra-osseous consequences of cholecalciferol. Vitamin D is a steroid hormone that is required for hormonal homeostasis and plays a role in a variety of physiological processes as well as human health [2].

Ergocalciferol (vitamin D2, which was found initially) and cholecalciferol (vitamin D3) are the two types of vitamin D. (Fig. 1).

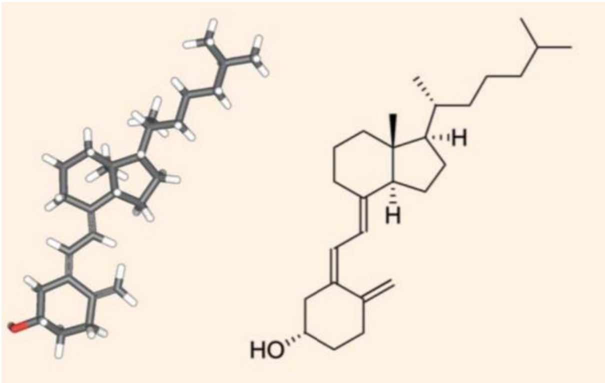


Fig 1. Cholecalciferolum [3].

Vitamin D is a provitamin in both forms. Vitamin D is activated by hydroxylation in the liver, which produces 25-hydroxy-cholecalciferol (25(OH)D_3, calcidiol), which is then converted into the active form of vitamin D-1,25- dihydroxy-cholecalciferol (1,25(OH)2D_3, calcitriol or D-hormone) by 1-hydroxylase in the renal tubules or placenta in pregnant women [4]. Vitamin D works through attaching to the vitamin D receptor (VDR), nuclear steroid receptor, and intracellular transcription factor in a number of organs. VDR expression regulation is one of the key mechanisms by which target cells respond to calcitriol in such a way that VDR polymorphisms alter the normal mode of operation [5, 6]. Vitamin D receptors can be found in the uterus, ovaries, placenta, and pituitary gland tissues. Vitamin D inhibits the renin-angiotensin system and vascular smooth muscle cell proliferation, lowers blood insulin levels, promotes endothelium-dependent vasodilation, and inhibits anticoagulant activity, all of which help to prevent arterial hypertension. Vitamin D's active form controls the expression and activity of genes involved in trophoblast invasion, proper implantation, and angiogenesis [7-9].

In today's global and domestic agro-industrial complex, chicken farming is the most science-intensive and dynamic branch. This is due to the high quality of poultry meat and the fact that eggs provide a comprehensive and cost-effective source of protein for many sectors of the population. Modern diet should provide preventative and therapeutic activities in addition to meeting the body's physiological needs for energy and plastic chemicals. It is possible to develop food products with desired features by supplementing the diet of chickens with ecologically friendly, effective preparations. Such goods include food eggs [10].

The aim of the study was to study the influence of the season of the year on changes in vitamin D in chicken eggs.

Experimental part

The experimental part of our research was aimed at determining the amount of vitamin D_3 in chicken eggs.

To begin, qualitative tests for the presence of vitamin D in a chicken egg were performed. An alcoholic solution of egg extract and a solution of bromine in chloroform (1:60) were placed into a dry test tube to accomplish this. The solution turned a greenish-blue tint, which indicated the presence of vitamin D. Spraying a chloroform solution of antimony pentachloride on the chromatogram of an ethanol extract of an egg produces a brownish-blue hue, which is indicative of group D vitamins.

Separation using electrophoretic methods of column chromatography failed because the biomaterial is the most multicomponent system, containing roughly 50 different trace elements and compounds. These approaches did not differentiate individual type clustering chemicals from one another. Based on this, we concluded that vitamin D_3 forms a strong conglomerate complex with phospholipids, proteins, amino acids, and other nitrogenous bases in the egg, which had to be destroyed by the action of acetyl chloride as an acylating agent for binding high-molecular protein components and nucleophile-containing compounds (amino acids, phenols). Vitamin D_3 in the biomaterial was associated with antimony (III) chloride to form a colored product, necessary to determine the optical density of the solution, which serves as a measure to clarify the amount of vitamin D_3.

A calibration curve was built by plotting the optical density (D) values of the solutions at 260 nm [11, 12, 13].

As a biomaterial for the experiment, we used egg yolks of local domestic chickens and chickens of the so-called German breed, which were kept in the vivarium of the Central Scientific Research Laboratory under standard conditions.

Results and discussion.

The obtained research data are presented in Table 1.

Table 1. The results of determining the content of vitamin D_3 in chicken eggs in different seasons of the year (in mcg/100g)

experience №	Winter		Spring		Summer	
	German breed	Local breed	German breed	Local breed	German breed	Local breed
n_1	4,0	4,1	6	9,2	6,2	9,5
n_2	3,3	3,9	5,0	8,6	7,0	9,6
n_3	3,1	4,2	7	8,0	7,2	8,9
n_4	4,1	4,0	6,9	9,6	6,0	9,
n_5	4,0	4,5	5,1	9,7	6,6	9,6
$\sum n$	18,5	20,7	30	45,1	33,0	47,8
$\sum_n/n$	3,7	4,14	6,0	9,0	6,6	9,5
$\Delta\pm_s$	0,7	0,8	0,7	1,6	1,3	1,7

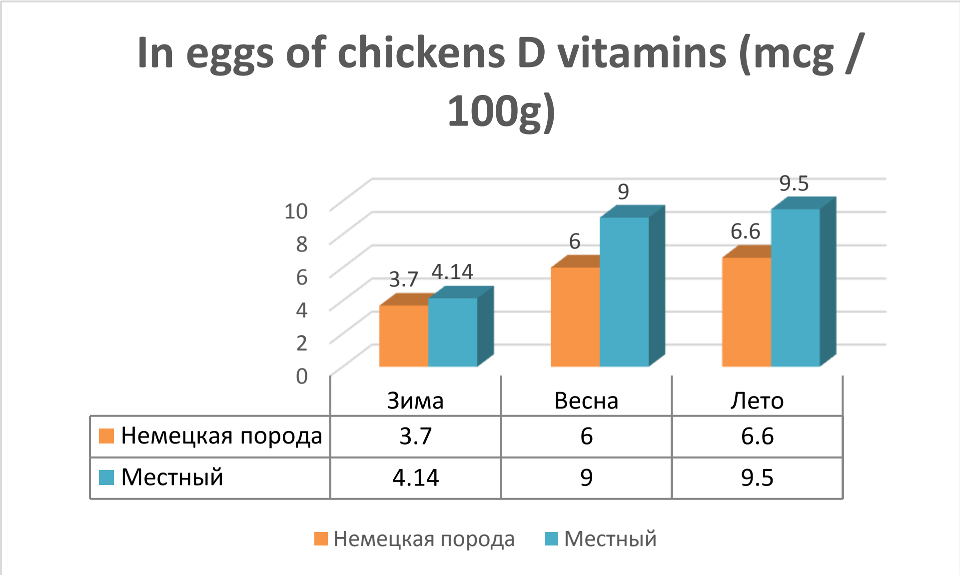
Table 1 shows that the quantitative indicators of vitamin D_3 in the egg yolk of German breed chickens in all seasons are significantly lower than in local chickens.

These values in the German breed were 3.7±0.7mcg per 100g of product in winter, 6±0.7mcg per 100g of product in spring, and 6.6±1.3mcg per 100g of product in summer. Whereas in the eggs of the local breed, these indicators were 4.14±0.7; 9.0±1.6 µg and 9.5±1.7, respectively. According to the results of the analysis, the quantitative indicators of vitamin D in the yolks of chicken eggs change according to the seasons of the year.

These figures show that the amount of vitamin D in domestic chickens during the winter period is 11.89% higher than in the German breed during the same period; indicators in the spring by 50.0%; indicators in the summer by 44.0% than in the eggs of German chickens.

The amount of vitamin D in the eggs of hens of both breeds varies greatly depending on the season. These figures are even more clearly visible in the histogram shown in Figure 2.

In particular, the amount of vitamin D in the eggs of German chickens in spring is 62.2% higher than in winter, in summer - by 78.4%, and in domestic eggs - by 117.9 and 129.5%, respectively.



	Зима	Весна	Лето
Немецкая порода	3.7	6	6.6
Местный	4.14	9	9.5

Figure 2. Seasonal change in the content of vitamin D in the yolk of a chicken egg.

It should be noted that domestic chicken eggs are high in vitamin D.

Conclusions

1. Quantitative indicators of the content of vitamin D in the yolk of chicken eggs vary depending on the season. These values are 3.7 ± 0.7 μg per 100 g of product in winter for German chickens, 6 ± 0.7 μg per 100 g of product in spring, 6.6 ± 1.3 μg per 100 g of product in summer. Whereas in the eggs of the local breed, these indicators were 4.14±0.7; 9.0±1.6 μg and 9.5±1.7, respectively.
2. The amount of vitamin D in the eggs of domestic hens is 11.89% higher in winter, 50.0% in spring and 44.0% higher in summer than in eggs of German breeds.

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