International Journal of Life Science and Agriculture Research

ISSN (Print): 2833-2091, ISSN (Online): 2833-2105

Volume 03 Issue 07 July 2024

DOI: https://doi.org/10.55677/ijlsar/V03I7Y2024-12

Impact Factor: 6.774 , Page No : 585-589

Biological Roles of Methionine and its Effect on Hatched Embryos and the Performance of Broiler: A Review Article

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ABSTRACT: The development taking place in the growth of poultry birds has prompted researchers and specialists in the field of bird nutrition to search for solutions and food alternatives that are less expensive and with the same nutritional value to compensate the birds and balance their diets to meet the needs of mineral elements, vitamins and amino acids (protein). In view of the increasing demand for meat, this increase has been met with a steady increase. The use of manufactured feed additives and antibiotics had a negative impact on the growth of poultry, and some of them were deposited in the edible tissues of the bird. They were thus transmitted to the consumer, causing many diseases. Given the primary purpose of the additives, which is to balance all the elements involved in the composition of bird feed, I considered safe food additives such as liquid solutions and a group of vitamins, amino acids, and plant extracts, and since the primary return from most poultry projects is the economic return, the main goal was to focus on sources of amino acids as they are the basic unit for building protein, including the amino acid methionine as it is part of a group of amino acids called the determining factors in the composition of diets.

Published Online: July 16, 2024

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KEYWORDS: amino acids, methionine, bird nutrition, early feeding.

INTRODUCTION

Modern breeds of broilers are characterized by rapid growth and improved production performance represented by their high body weights and efficient nutritional conversion of food, which makes them suffer from a lack of energy supplies and some essential nutrients such as amino acids, vitamins, and minerals, which requires relying on early feeding of the embryos of hatching eggs produced for such breeds. The technology of injecting hatching eggs with some nutrient solutions is one of the most critical technologies that contribute to ensuring the vitality of embryos and producing healthy chicks with good health and distinguished production performance (Al-Saeedi, et, al., 2022). Many studies have shown the importance of injecting nutrient solutions such as amino acids, vitamins, and minerals (Salman, et, al., 2024) or probiotics, probiotics, and vitamin C (Salman, et, al., 2024).

Such technology plays a vital role in accelerating the process of absorbing the egg yolk from the yolk sac and reducing the cases of chicks being exposed to yolk sac infection and omphalitis, in addition to accelerating the development process of the digestive and immune systems and the thermoregulation system and reducing the mortality of chicks during the first days of their life and preventing them from being exposed to dehydration because nutrition Early and accelerating the absorption of the yolk sac and the assimilation of fats leads to the production of an amount of water called metabolic water. Amino acids are the basic building unit of protein (Zaki and Dakhal, 2021), in addition to being one of the essential nutrients in poultry diets (Guoyao, 2013), Therefore, early feeding of the embryos helps the hatched chicks overcome the stress of hatching and improve digestive ability by improving the digestive system, which begins to develop during the incubation period for hatching and the completion of enzymatic activity and the readiness of the digestive tract and absorption before hatching, (Al-Assadi and Al-Hasani, 2007), Al- Daraja and Al- Hassani (2000) concluded that injecting chicken egg embryos with liquid nutrient solutions that include essential vitamins, minerals, and amino acids leads to an increase in the hatchability rate, in addition to an increase in the weight of the chicks upon hatching and an increase in their marketable weight rates.

Methionine is classified as an essential amino acid for poultry birds because the birds are unable to manufacture their carbon skeleton, or it may be produced in tiny quantities that do not meet the requirements of the bird's body. Burley et al., 2016. It is considered one of the vital sulfur amino acids, and it is the primary determinant of the growth and development of the poultry birds it is fed. It contains plant proteins, so it must be added for the purpose of balancing the diet, as it is one of the essential nutrients

involved in a number of vital activities in the body (Ahmed and Abbas, 2015). Methionine, in its industrial form, is added to diets to meet the birds' need for this vital acid, and it is considered a type of DL. -Methionine is the most common for use in poultry feeds - Hadinia et al., (2014), Recently, a significant trend has emerged from the World Health Organization (WHO), the US Department of Agriculture's National Organic Program (NOP), and other food organizations regarding the need for it to be used in poultry feeds, animal-free from chemical additives. Chattopadhyay et al., (2006) found that herbal methionine made its way into the poultry feed industry after obtaining encouraging results in a number of research studies at universities and research centers in most countries of the world. It is described as an extract of a group of medicinal herbs and plants such as Mucuna pruriens, common neem, and Azadirachia indica. , hummus, Trigonella 2foenumgraecum, onion, Allium cepa, garlic, Allium sativum, and Boerhavia (Yuan et al., 2012). These plants are treated specially for the purpose of extracting natural methionine, free of chemical compounds, and providing what international food and agricultural organizations aspire to.

A brief history of methionine synthesis:

Methionine was manufactured in the first years of the last century, specifically in the year 1923, when Mueller (1923) isolated the sulfur amino acids, including methionine, and arrived at its final formula. This scientist gave a short name for this amino acid, which is methionine, as described by Barger and Coyne. Synthesis of methionine with the formula Meththiol α-butanoic acid.

Methionine

This acid is known as one of the essential amino acids necessary for birds and mammals. It is one of the sulfur amino acids (Sulfur Amino Acid (SAA). It is classified as a neutral amino acid because it contains one amino group and one carboxyl group. The L-methionine form represents the common natural form of the acid. In contrast, the mixture represents DL-Methionine and its precursor DL2-hydroxy-4-methionine butanoic acid (HMTBA), the two most common industrial sources in bird diets (Goodson et al., 2012), have a white crystalline form, are solid in texture, and have a distinctive odor (Michael and Nelson, 2015).

Sources of methionine

Birds cannot synthesize methionine within their bodies Ahmed and Abbas (2015), so methionine is synthesized from plants and by most microorganisms, and the enzymes responsible for the reactions of converting cystine to methionine found in bacteria are the same as those found in plants (Giovanelli, 1987) and because the plant is the source The primary source of methionine, which is provided to the bird's body through feed materials used in formulating rations, is that some plants contain specific amino acids. Therefore, their nutritional value needs to be increased to meet the needs of birds. For example, the grains of grasshoppers contain limited amounts of the essential amino acids tryptophan and lysine. And threonine, such as wheat, barley, oats, rye, rice, yellow corn, white corn, and millet (Amir, 2008). While legumes such as lentils, soybeans, peas, mung, beans, chickpeas, alfalfa, and jet mainly contain limited amounts of sulfur-containing amino acids, including methionine and cysteine (Galili et al., 2005).

Effect of herbal and synthetic methionine on the productive performance of birds

Specialists in the field of poultry nutrition recommend that the level of essential amino acids in general and methionine, in particular, be raised when raising modern breeds of broilers that are characterized by high growth speed, as the addition of methionine must meet the birds' needs, to achieve a balance between methionine and other amino acids that are involved in the synthesis of A specific protein, which in turn will stimulate: growth, increased body weight, reduced fat accumulation in the carcass and improved efficiency of utilization of spent feed (Bunchasak); Hoehler et al., 2009 (Hoehler et al., 2005), there are a group of studies that addressed the issue of using herbal methionine and adding it to broiler diets as an alternative to synthetic methionine. Most of these studies focused on the biological effectiveness of this source in the performance of broilers on the one hand, and on the other hand, studying its efficiency in comparison. With the industrial source, Chattopadhyay et al. (2006) noted that adding herbal methionine to broiler diets at a rate of 0.2 kg/ton of feed led to superior body weight, weight gain, and feed conversion coefficient compared to the use of synthetic methionine. The same study showed that the total protein concentration and activity of The enzymes AST and ALT in the birds' blood serum did not change and were within the normal range when adding herbal methionine. The same percentage of herbal methionine achieved the highest clearance percentage, the lowest abdominal fat content, and the highest percentage of breast and thigh segments compared to the addition of synthetic methionine. In another study, it was shown that adding herbal methionine in percentages 0.7 kg/ton has improved, with a highly significant $P<0.01$, cumulative body weight rate, and feed conversion factor compared to synthetic methionine at the same ratio. Halder and Roy (2007), Kalbande et al. (2009) stated that adding herbal methionine at a ratio of 1 kg/ton tons led to an improvement in the rate of weight gain and feed conversion efficiency of broiler chickens compared to the same percentage of synthetic methionine, and when measured by the enzymatic activity of AST and ALT and the concentrations of cholesterol and triglycerides in the birds' blood serum when adding herbal methionine compared to the control treatment, and when it was replaced by Kumari et al., (2012).) Partially synthetic methionine with herbal methionine at a ratio of 1 kg synthetic/ton of feed + 1 kg herbal/ton of feed and adding it to broiler diets. Note that there was a significant increase in the clearance rate with a significant decrease in the relative weight of abdominal fat compared to adding 2 kg of synthetic methionine. It was concluded that adding herbal methionine had a positive effect on the quality

characteristics of the carcass compared to synthetic methionine. Adarsh et al. (2014) indicated that adding herbal methionine at a rate of 1.5 kg/ton to the diet of broilers achieved the highest weight gain and feed conversion efficiency compared to synthetic methionine. In the same study, the herbal methionine treatment recorded the highest feed conversion efficiency at the third week of life. Compared to synthetic methionine. Ahmed and Abbas (2015) stated that 1.5 kg herbal methionine/ton of feed compared with the same ratio in broiler diets led to a significant increase in both body weight and the rate of weight gain compared to the same ratio of synthetic methionine. They also noted that feed consumption increased. Significantly, when raising the methionine percentage to 2 kg per ton of feed.

While Soetan, et, al., (2010) noted that adding herbal methionine to quail diets did not record any adverse effect on their performance, on the contrary, the addition treatments with herbal methionine recorded a significant increase in egg weight rates and related measurements, such as the weight of the yolk, the white, and others, as the researcher confirmed on the possibility of replacing synthetic methionine with herbal methionine due to its superiority in all the parameters of the study and for most of the properties studied.

Early feeding of chicken embryos

The process of embryonic development of egg embryos and during the hatching process is affected by many factors, including the contents of the egg that the embryo needs for embryonic development, the growth of tissues until the time of hatching, the ability of the digestive tract to digest and absorb nutrients, and the ability of chicks to rely on the remains of nutrients in the yolk sac during the first days following the process. Hatching. All of these factors will affect the productive performance of the hatched chicks and affect by 2-5% the vitality of the chicks, their growth rate, the efficiency of their feed consumption, and their resistance to diseases (Uni et al., 2005). The hatching process requires energy, and the hatched chicks may suffer from nutritional stress in the event of Their need to use glycogen from the liver and bodily muscles and that small amounts of necessary carbohydrates remain before hatching to nourish the embryos in that critical period, which is reflected in the chicks after hatching because the main store of glycogen is the liver and bodily muscles, which begin to decrease upon hatching and then begin to increase when the newly hatched chicks reach the stage of Fully consuming oxygen and using the fat stored in the yolk (Salman, et, al., 2024). Therefore, early feeding of the embryos helps the hatched chicks overcome the stress of hatching and improve digestive ability by improving the digestive system, which begins to develop during the incubation period for hatching, completion of enzymatic activity, and readiness of the duct. Digestive and absorption before hatching (Kadam, et, al., 2008), Ajayi, et, al., (2022) concluded that injecting chicken egg embryos with liquid nutritional solutions that include the necessary vitamins, minerals, and amino acids leads to an increase in the hatching rate as a result of providing the embryos with the energy that the chick needs to break the egg, in addition to Increasing the weight of chicks upon hatching and increasing their marketing weight rates. The same researcher mentioned the importance of early nutrition for egg embryos, which leads to accelerating the process of absorbing the egg yolk from the yolk sac and inflammation of the umbilicus, in addition to accelerating the development process of the digestive and immune systems and the thermoregulation system, reducing the number of deaths among the hatched chicks during the first days of life, and preventing the hatched chicks from being exposed to dehydration because Early feeding and accelerating the absorption of the egg yolk and fat metabolism lead to the production of an amount of water called metabolic water. Many nutrients and antibiotics were used, such as tetracycline and chloramphenicol (Mohammadrezaei, et, al., 2015). The results of the research showed an improvement in the hatching rate and an increase in the weight of the hatched chicks when such methods were used. Antibiotics.

As for Kachungwa lugate, et, al., (2022), he indicated that injecting solutions containing glucose, lysine, methionine, and ascorbic acid into the amniotic sac of egg embryos at a concentration of 1% and at a dose of 0.1 ml for each egg in the amniotic sac and that these elements led to improving most of the productive and physiological characteristics of the hatched chicks. He attributed this to The importance of injected glucose, which contributed to improving the conditions for providing energy to the fetus and the hatched chick to benefit from it in the process of digestion, absorption and metabolism. Researchers Nazem, et, al., (2015) also agreed that injecting different concentrations of folic acid at a rate of 0, 5, 15, and 25 micrograms per embryonic egg on the second and sixth days of incubation noted a significant improvement in the hatching rate of the injected eggs and a decrease in the number of embryonic deaths. This was attributed to the importance of Folic acid increases the number of red blood cells, develops the nervous system of fetuses, and increases the vitality of chicks due to the role of this vitamin in improving protein synthesis and nutritional metabolism of fetuses. Chen, et, al., (2020) reported the importance of injecting glucose, lysine, methionine, ascorbic acid, vitamin B, and the probiotic into the amniotic sac of embryonic eggs. He noted an improvement in the hatching rate, a reduction in the number of embryonic deaths, and an increase in the weight rates of the hatched chicks for treatment with glucose, lysine, and methionine injections and that the injected probiotic and vitamin B complex did not affect those qualities. Coskun, et, al., (2018) mentioned the importance of injecting the probiotic and vitamin C into the embryonic eggs in the stork sac and noted the effect of these two elements in improving the hatching rate and the weight of hatched chicks, despite the expansion of studies and research into injecting nutrient solutions into eggs, hatching, However, current studies have not addressed the injection of some plant extracts and their effect on the hatchability rate of fertilized eggs and the number of dead eggs, nor have they examined their toxic effect,

what is their mechanism of action, and whether they have positive or negative effects on the vitality of chicks and their impact on the subsequent productive performance of broilers.

CONCLUSIONS

From the studies presented above by a number of researchers, it can be concluded:

1- The possibility of injecting herbal methionine into the hatching eggs of broiler chickens without any toxic effect.

2- It is possible to substitute herbal methionine instead of synthetic methionine in poultry diets. It has had the most significant impact in improving the hatchability rate and vitality of the hatched chicks, which reflects positively on increasing the subsequent productive performance of the broilers and increasing their body weights.

3- Injecting hatching eggs with nutrient solutions, including methionine and vitamins, played a prominent role in reducing the number of embryonic deaths and increasing the hatching rate.

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