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(54) Titre : METHODE POUR AUGMENTER LE TAUX D'ECLOSION DES OEUFs EN DONNANT AUX POULES DE LA
CARNITINE VIA LA NOURRITURE

(54) Title: METHOD OF INCREASING THE HATCHABILITY OF EGGS BY FEEDING HENS CARNITINE

(57) **Abrégé/Abstract:**

The present invention relates to a method of feeding female birds with a feed formulation which enhances the hatchability of the eggs laid, as evidenced by an increase in hatching percentage. Poultry diets of this invention include an effective amount of a carnitine, such as L-carnitine or a L-carnitine salt. The effective amount present in the diet is such that the hatchability of eggs laid by hens fed this diet is increased.



ABSTRACT OF THE DISCLOSURE

The present invention relates to a method of feeding female birds with a feed formulation which enhances the hatchability of the eggs laid, as evidenced by an increase in hatching percentage. Poultry diets of this invention include an effective amount of a carnitine, such as L-carnitine or a L-carnitine salt. The effective amount present in the diet is such that the hatchability of eggs laid by hens fed this diet is increased.

The present invention relates to the general field of poultry farming and the feeding of fowl, including layers and broiler breeders. In particular, the present invention relates to a method of feeding female birds with a feed formulation which enhances the hatchability of the eggs laid, as evidenced by an increase in hatching percentage. Poultry diets of this invention include an effective amount of a carnitine, such as L-carnitine or a L-carnitine salt. The effective amount present in the diet is such that the hatchability of eggs laid by hens fed this diet is increased.

Previous studies have attempted to correlate hen production performance with diet. Lee et al (Korean J Anim Sci 27:3:161-168, 169-175; 1985) identify the energy and protein requirements of broiler breeder hens between 24 and 64 weeks of age. Although these optimum diets increased egg production at certain age stages, no increase in hatchability was seen with diets having optimum energy or protein levels. Similar studies by Lilburn et al (Poul Sci 69:7:1126-1132; 1990) and Waldroup et al (Poul Sci 55:6:2342-2347; 1976) also fail to report an effect of diet on hatchability.

Carnitine in poultry diet has been shown to have no effect on feed intake, body and abdominal fat weight or on carcass or liver lipid levels (Cartwright, Poul Sci 65:Suppl. 1:21; 1986). Dietary carnitine has been shown to retard ethanol metabolism in broilers (Smith et al, Poul Sci 71:Suppl. 1:64; 1992). However, neither of these reports discuss the effect on the hatchability of the eggs laid by hens on such a diet.

Carnitine was found not suitable as a substitute for choline in the diet of quail (Chang et al, Poul Sci 54:5:1718-1720; 1975). In a control experiment of this study, carnitine was used as an additive to a standard diet containing choline. The added carnitine decreased the

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hatchability of the quail eggs. This observed decrease
could be due to one or both of the following differences
5 between this experiment and the present invention. Chang et

al used racemic carnitine (a mixture of both the D- and L-isomers), where L-carnitine is presently preferred. More importantly, the carnitine concentration was more than twice the upper concentration limit recommended by the present disclosure, i.e. 1400 mg/kg vs. about 675 mg/kg. As discussed below, the present inventors believe that there is an upper concentration limit for effectiveness.

Several patents have been issued which provide methods of increasing the hatchability of eggs. United States Patent Number 2,734,482 (Seltzer) involves distribution inside the egg of sex hormone, such as estrogen or androgen, by wetting the outside of the egg shell with a liquid formulation of the hormone. Such treatment is said to improve the hatchability and viability of the resulting chicks. United States Patent Number 4,604,968 (Christensen) discloses an increase in hatchability through the injection of eggs with a substance which increases the endogenous thyroid output of the developing embryo. United States Patent Number 4,973,595 (Robel) discusses the increase in hatchability of turkey eggs by injecting pyridoxine at a particular developmental stage.

All of these patented methods involve treatment of the eggs themselves, and thus are labour intensive and would involve major alterations in handling of the laid eggs. Therefore, there remains a need in the art for a method of increasing hatchability of the eggs which can be easily incorporated into existing farming techniques.

According to one aspect of the present invention, there is provided the use of carnitine for increasing the hatchability of eggs laid by a breeder hen.

According to another aspect of the present invention, there is provided a feed formulation for poultry comprising crude protein, crude fat, crude fiber and carnitine.

The goal for broiler breeder stock in the United States is about 12 dozen hatching eggs per hen housed in 36-40 weeks production, resulting in about 110-115 broiler

chicks per breeder female housed. Table 1 documents a sample plan which achieves a performance goal in this range. As evident from Table I, there are a number of variables which affect the attainment of these goals, including the percentage of hens producing, the mortality of the hens, the number of eggs laid, and the percentage of the eggs which hatch.

TABLE I
Broiler Breeder Performance Goals

Age, Weeks	Prod. % Hen Day	Mort. %	No. Hens End of Period	Fd/Doz. ¹ lbs.	No. Eggs ² Period	Hatch. Eggs, %	No. Hatch Eggs	Hatch %	No. Chicks/ Period
5	5.0	.20	998	77.82	349	-	-	-	-
6	18.5	.20	996	22.38	1,290	-	-	-	-
7	37.5	.25	994	11.04	2,609	55	1,435	65	933
8	55.0	.25	991	7.53	3,815	62	2,365	75	1,774
9	72.0	.25	989	5.75	4,985	70	3,490	82	2,862
0	79.0	.25	986	5.24	5,453	80	4,362	87	3,795
1-34	78.0	1.00	976	5.31	21,316	87	18,545	88	15,919
5-38	74.0	1.00	966	5.59	20,016	92	18,414	85	15,652
9-42	70.0	1.00	956	5.91	18,738	97	18,176	84	15,268
3-46	66.0	1.00	946	6.27	17,482	97	16,958	83	14,075
7-50	61.5	1.00	936	6.73	16,118	97	15,534	82	12,820
1-54	57.5	1.00	926	7.20	14,909	97	14,462	80	11,570
5-58	53.0	1.00	916	7.81	13,593	97	13,185	78	10,284
9-62	48.5	1.00	906	8.54	12,303	97	11,934	76	9,070
Average Total	60.3	9.40		6.86	152,976	97	138,960	82	114,052
¹ Based on a feeding rate of 32 pounds/bird or .345 lbs./hen/day with 7 males/100 females. ² Based on 1000 hens at 24 weeks.									

Increasing hatchability, that is, increasing the percentage of laid eggs which hatch, is particularly desirable, as even a small increase in percentage will significantly affect the resulting chick numbers. Therefore, increased hatchability is considered an important factor in large scale breeding programs.

The present inventors have surprisingly discovered that supplementing standard broiler breeder diets with carnitine results in a significant increase in hatchability of eggs laid by the hens. This improvement results in greater chick numbers, thus allowing production goals to be reached or exceeded. The increase in hatchability is concentration dependent, with both lower and upper concentration limitations.

Without being bound by theory, it is believed that a breeder hen diet supplemented by carnitine results in an increase in carnitine concentration in the egg. As carnitine is well known for its ability to increase fat utilization, it is theorized that the increased concentration in the egg allows the embryo to more easily employ the stored fat of the egg, thus increasing the chances of survival for the embryo.

The present invention relates to a diet for breeder hens which comprises carnitine. The carnitine is present in concentrations which make the diet suitable for use in the method of the present invention. The present method increases the hatchability of eggs laid by hens fed the diet of the present invention.

Suitable poultry to be fed the diet of the present invention include but is not limited to the female breeder hens of chickens, turkeys, ducks, pigeons, quail, or any other poultry species which has female breeders.

The supplemental carnitine can be any isomer of carnitine, preferably L-carnitine. Also suitable for formulation of the diet of the present invention are salts of carnitine, such as acetyl carnitine. The carnitine is present in an effective amount, where the desired effect is an increase in the hatchability of eggs laid by hens fed the diet. This increase can be of any level above the hatchability of eggs of hens fed the diet without the carnitine supplement, as even very small differences in hatchability have significant effect on the number of chicks

produced. This is due to the large number of eggs produced in a production season.

Experiments by the present inventors indicate that not only is there a minimum amount of carnitine which can be considered effective, but that large concentrations of carnitine also reduce the hatchability seen, although the percent hatching observed is still above the levels seen with eggs from the control hens. However, given the detailed guidance of the present specification, it is believed within the level of one of ordinary skill to test a range of carnitine concentrations using a trial feed in order to optimize the concentration for the particular species and breed being fed. Generally, effective concentrations range between about 5 and about 500 ppm of the feed. For broiler breeder hens, particularly the Hybro strain Euribrid, concentrations of carnitine between about 20 and about 100 ppm of the feed have been shown effective, with the preferred concentration being about 50 ppm.

The base diet of the present invention can be any poultry diet known to those skilled in the art, including those used to control body weight such as "low protein" formulations, "low energy" formulations or lysine deficient rations. Generally, a typical diet will include a selection of the ingredients described below. The final formulation, prior to carnitine addition, will generally contain from about 12 to 25% crude protein, from about 0.5 to 10% crude fat, and from about 2 to 12% crude fiber.

The primary component is generally grain and processed grain by-products, such as corn, corn hominy, corn germ meal, barley millet, oats, rice, rice hulls, rye, sorghum, wheat and wheat shorts. These are considered "energy" ingredients, supplying carbohydrates with some protein.

The feed can also include plant protein products, such as soybean oil meal, alfalfa meal, barley malt sprouts, coconut meal, corn distillers grain, corn gluten meal, cottonseed meal, pea seed, potato meal, peanut meal,

sunflower meal, wheat germ meal, and brewers' yeast. These are considered "protein" ingredients, supplying protein to the diet.

Feeds generally contain animal and fish by-products such as blood meal, blood flour, dried buttermilk, dried whey, dried casein, fish meal, dried fish solubles, liver meal, meat meal, meat meal tankage, bone meal and dried skim milk. Anchovies, herring and menhaden are well-known sources of fish meal.

The feed is often supplemented with minerals and synthetic trace ingredients. Vitamins often used include B-12, A, pantothenate, niacin, riboflavin, K, folic acid, and the like. Amino acids such as DL-methionine are often added, as well as trace minerals including choline chloride, dicalcium phosphate, magnesium sulfate, potassium sulfate, calcium carbonate (limestone, oyster shells), salt, sodium selenite, manganous oxide, calcium iodate, copper oxide, zinc oxide, and D-activated animal sterol.

Molasses and animal fats are added to improve palatability and to increase or balance energy levels.

The feed can also contain preservatives such as ETHOXYQUIN® and sodium sulfite.

The feed schedule and feed rates can also be any standard schedule and rate used in the art, including feed restrictive programs.

The following Example is representative of the present invention but is not to be considered limiting to the scope of the invention.

EXAMPLE

A total of 5,400 commercial hens, Hybro strain Euribrid, were divided into groups of 1,350 birds and fed diet compositions containing various levels of L-carnitine. Table II documents the nutrient composition of the diets, as well as the analyzed L-carnitine levels.

TABLE II

Nutrient Composition (%)	Control	20 ppm	50 ppm	100 ppm
Dry Matter	89.94	89.87	90.37	90.07
Ash	9.83	11.35	10.73	10.58
Crude Protein	17.71	17.89	17.89	18.02
Crude Fat	5.7	5.8	8.08	8.06
Crude Fibre	2.89	2.87	3.04	3.06
N-Free Extract	53.91	52.06	52.88	52.35
L-Carnitine (analyzed) mg/kg	13	29	86	135

The hens were maintained on this diet for thirty days, during which the hatchability, as measured by percentage of incubated eggs, was determined. Table III summarizes the results for each of the 4 diets tested.

TABLE III

Group	Hatchability (percentage of incubated eggs)				
	Day 1 - 7	Day 8 - 14	Day 15 - 21	Day 22 - 28	Day 29 - 35 Control - 100
Control	81.3	79.6	84.4	81.78	100
20 ppm	78.2	82.00	85.95	85.90	105.1
50 ppm	83.00	81.10	87.00	87.00	106.4
100 ppm	82.40	81.00	88.50	84.30	103.1

The above results suggest the use of carnitine in poultry feed to increase hatchability of eggs laid by hens fed with the feed. Specifically suggested is the use of L-carnitine, in the concentration range of from about 20 to 100 ppm, with the preferred concentration being about 50 ppm. The above results also suggest that as the carnitine concentration increases above about 50 ppm, the

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effect on hatchability may be reduced. Extrapolation from this data indicates that there is an upper limit in carnitine concentrations which are effective in increasing egg hatchability.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. The use of an effective amount of carnitine added to a feed for increasing the hatchability of eggs laid by a breeder hen.

2. The use according to claim 1, wherein the carnitine is selected from the group consisting of L-carnitine, D-carnitine, DL-carnitine and salts thereof.

3. The use according to claims 1 or 2, wherein the carnitine is L-carnitine.

4. The use according to any one of claims 1 to 3, wherein the effective amount of carnitine is added to the feed in the range of from about 5 ppm to about 500 ppm.

5. The use according to any one of claims 1 to 4, wherein the effective amount of carnitine added to the feed is about 50 ppm.

6. A feed formulation for poultry comprising crude protein, crude fat, crude fiber and an effective amount of carnitine.

7. A feed formulation according to claim 6, wherein the carnitine is selected from the group consisting of L-carnitine, D-carnitine, DL-carnitine and salts thereof.

8. A feed formulation according to claims 6 or 7, wherein the carnitine is L-carnitine.

9. A feed formulation according to any one of claims 6 to 8, wherein the effective amount of carnitine is in a range of from about 5 ppm to about 500 ppm.

10. A feed formulation according to any one of claims 6 to 9, wherein the effective amount of carnitine is about 50 ppm.

11. A feed formulation according to any one of claims 6 to 10, wherein a concentration of crude protein is in a range of from about 12 to 25%.

12. A feed formulation according to any one of claims 6 to 11, wherein a concentration of crude fat is in a range of from about 0.5 to 10%.

13. A feed formulation according to any one of claims 6 to 12, wherein a concentration of crude fiber is in a range of from about 2 to 12%.