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RESEARCH ARTICLE

CONVENTIONAL VERSUS INNOVATIVE METHOD OF SEPARATE CALCIUM FEEDING IN LAYING HENS

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Abstract

A specific appetite in calcium has been identified during the egg formation in laying hens therefore it is recommending to use a Separate Calcium feeding (SCF) in laying hens. The present study aimed to the. Investigate the timing in the distribution of calcium meal a cafeteria system. A conventional SCF system was compared with an Innovative SCF system. Both system was equipped with a feeder containing a diet with low-calcium (2986.44 Kcal/kg and 19.14% crude protein; 0.7% and the last feeder containing CaCo2 (carbonate of calcium) In each group , a sample of 25 laying hens , 27 week-old was involved in the experiment...Laying hens in the conventional SCF group received early in the morning (7.00 AM) both feeders containing a diet with low-calcium and feeder with calcium meal whereas, in the Innovative SCF group, received diet with low calcium meal in the morning while the feeder congaing calcium meal was served in the afternoon (2 PM.). The two batches were monitored for six weeks on the variables of voluntary consumption of total food, calcium meal and egg production. The calcium feed intake in laying in the Innovative SCF was significantly higher ($p<0.05$) than in the conventional SCF (5.77g vs 7.08g) indicating a specific appetite in calcium during then egg formation process. Consequently, egg production was improved also significantly improved the average number of eggs laid (+4.32%), The suggested to distribute a low calcium diet in the morning and calcium meal in the afternoon, this in accordance with the physiology of laying hens during egg formation in tropical areas where the productivity of laying hens are limited by heat stress.

Introduction:-

In tropical countries, high ambient temperatures remain one of the main factors limiting the productivity of laying hens, followed by feeding. Although, high temperatures in tropical zones have direct effects on the reproductive

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function (; Picard, et al. 1993), they also affect feed intake mainly including the calcium required for shell formation (Banga-Mboko 1998; 2001;2003).

During the eggshell formation, the calcium requirement of laying hens is higher. In addition, several studies have highlighted the inadequacy of laying hen nutrition have demonstrated the existence of a specific appetite for calcium in hens during egg formation (Mongin and Sauveur, 1979; Uzu, 1989.) Thus, the use of a balanced diet with an invariable level of calcium in laying hens does not take into account this specific appetite during the egg production.

They reported that the formation of eggs is a typically nocturnal cyclical phenomenon, during which the hen consumes a great amount of the calcium essential for egg formation. Thus, taking into account the hen's physiology and specific appetite for calcium at the time of egg formation, a separation of calcium meal from the rest of the nutrients has been suggested (Mongin and Sauveur, 1979; Uzu, 1989; Picard et al. 1993.).

Separate calcium feeding (SCF) consists of feeding a low-calcium basic feed and separately supplied calcium sources, with the aim of increasing egg production. In practice, ACS consists of distributing a calcium-depleted feed in a first feeder and the calcium portion in a second feeder.Separate Calcium Feeding had been tested in tropical and equatorial areas (Banga-Mboko et al2007; Mankpondji et al 2012; Mantsanga 2012; 2019; Mantsanga et al 2016Oliver and Malan 2000; Safaa et al 2008.The experimental design consist in control group where he is fed with containing calcium meal whereas the treatment group was fed in practice, ACS consists of distributing a calcium-depleted feed in a first feeder and the calcium portion in a second feeder. This is generally done in the morning, when calcium is not needed, as it does not correspond to the physiology of hens, whose calcification is a nocturnal phenomenon (see material and method, figure 1a).

Although egg production and shell quality were improved however calcium intake were lower in SCF than in control group where calcium was including in the diets The explanation is that calcium meal was given in the morning, when calcium is not needed, as it does not correspond to the physiology of hens, to whom the calcification is a nocturnal phenomenon.

In order to consider the nocturnal calcification of the shell, to increase the calcium intake, the present study suggests a new protocol. In this innovative technique, the first calcium-depleted fraction is proposed to be given fed in the morning, and the second fraction containing calcium sources in the afternoon (see figure1 b).

This work was therefore initiated to evaluate the response laying hens, taking into account the timing of calcium meal distribution.

The study hypothesizes that calcium meal will more consumed in the innovative group than in conventional group and may improve performance of laying hens.

Materials And Methods:-

Study area

This study was carried out in Brazzaville, Republic of Congo, on the experimental farm of the National Institute of Agronomic Research (IRA) located in arrondissement 2 Bacongo. Brazzaville's climate is humid tropical of the Bas-Congolese type, with mean annual temperatures around 25°C and slight temperature variations not exceeding 5°C. The maximum temperature does not exceed 35°C and the minimum remains above 20°. The climate is characterized by two seasons: a rainy season from October to May, with a dip in January, and a dry season from June to September. In recent years, there has been a trend towards a later start to the rainy season (Toli, 2020).

Animals and experimental conditions

A sample of 50 27-week-old layers from the Isa Brown strain was selected and divided into two groups as shown in Table I.

Table 1:- Experimental Design.

Indications	**Conventional Separate Calcium Feeding**	**Innovative Separate Calcium Feeding**
Number feeders	2	2

Feeders contents	1-Diet depleted in calcium sources 2-calcium meal	1-Diet depleted in calcium sources 2-calcium meal
Dispensing time	Both feeders are served at the same time in the morning	The feeder containing the calcium depleted feed is served in the morning and the second feeder in the afternoon.

Both groups received the same diet. Feed ration in the morning only for T0 and sequentially (T1).

The layout of the feed troughs containing the calcium-depleted feed and the calcium portion is shown in figure 3 for the control and figure 4 for the treated batch.

Fig. 1:- A. Control batch receiving the calcium-depleted fraction (linear feeder) and calcium intake (siphoid feeder) also in the morning.
Fig. 1.On field of Separate Calcium Feeding.

Fig. 2:- B. On-field Innovative Separate Calcium Feeding.

On the left laying receiving the calcium-depleted fraction on the left in the morning, and on the right receiving the calcium fraction in the afternoon.

The types of feed used in this study were manufactured at the experimental feed manufacturing unit. Table II illustrates the feed formula.

Table 2:- Diet formulation of both conventional and innovative separate calcium feeding.

Ingredients	**%**
Maize	30
wheat	20
Cassava flour	16
Palm oil	2
Cowpeas flour	13
Fish meal	6
Soya oil cake	12.4
Calcar	0
salt	0.5
Vitamins	0.1
Total	**100**
Calculated nutritional values	
EM(Kcal /kg)	2852.10
MAT%	17.65
Ca%.	0.7
Ratio	**161.52**

The hens have the same diet, but the difference lies in the time at which the limestone is distributed: morning for the control batch and afternoon for the treated batch.

Health monitoring

During the pre-trial phase, the birds were subjected to a medical prophylaxis program including vaccinations and preventive treatments During the 90-day experiment, the hens underwent no medical intervention apart from vitamin complex treatment after weighing and other handling of the birds to avoid stress.

Data collection

The calcium feed intake and feed consumption in g / bird/d were measured daily during all the experiment, throughout the. The mortality viability was determined dividing the number of the dead animals per those alive at the beginning of the experiment.

Eggs were recorded daily from week 30 to 35

Statistical processing and analysis

The data obtained in this experiment were entered into Excel and then transferred to R software version 3.3.3 in order to perform the analysis of variance (ANOVA) test to better assess the results. Comparisons were made at the 5% level. Two means were considered statistically different when the p-value was less than 0.05.

Results And Discussion:-

Results will cover feed consumption, water consumption and limestone consumption. They will also include the calculation of feed consumption index, egg-laying rate and egg-laying rate.

Effect of sequential separate calcium feeding on voluntary feed intake

Table 3. shows the evolution of voluntary feed consumption by birds on both diets during the experimental period.

Table 3:- Voluntary food consumption.

Age of layers (in weeks)	**Conventional Separate Calcium Feeding**	**Innovative Separate Calcium Feeding**
30	103.56 ± 4.62^{a}	99.22 ± 1.42^{b}
31	102.05 ± 1.45^{a}	100.43 ± 1.06^{b}
32	106.69 ± 2.28^{a}	103.63 ± 9.40^{b}
33	108.80 ± 3.78^{a}	106.56 ± 5.27^{b}
34	109.34 ± 4.38^{b}	102.27 ± 8.35^{a}
35	96.57 ± 9.93^{a}	92.42 ± 17.08^{b}
Mind	104.50 ± 4.41^{a}	100.76 ± 7.10^{a}

a, b: values with different letters on the same line are significantly different at the 5% threshold

The table shows that, voluntary feed consumption was significantly higher throughout the experimental phase, in favor of the conventional SCF. This results are in agreement of previous works in separate calcium feeding in moderate climate (Banga-Mboko, 1998; Banga-Mboko et al 2001, 2003)

Effect of separate calcium feeding on calcium consumption

Data are shown in Table 4.

Table 4.:- Calcium consumption.

Age of layers (in weeks)	Conventional Separate Calcium Feeding	Innovative Separate Calcium Feeding
30	5.08 ± 1.49^a	7.14 ± 1.06^b
31	4.70 ± 0.47^a	7.31 ± 0.60^b
32	5.83 ± 0.62^a	7.65 ± 1.36^b
33	6.25 ± 0.70^a	6.71 ± 1.38^a
34	6.30 ± 0.10^a	7.31 ± 0.75^b
35	6.48 ± 0.89^a	6.34 ± 1.88^a
mind	**5.77 ± 0.71^a**	**7.08 ± 1.17^b**

a, b: values with different letters on the same line are significantly different at the 5% threshold

As it can be seen the innovative SCF improved significantly (p) calcium consumption.

This can be explaining by the fact composed essentially of calcium carbonate, the hen's eggshell mobilizes a significant proportion of calcium for its formation, and its solidity therefore depends on suggesting the expression of a specific calcium appetite at the time of laying.

Egg collection

Results are shown in table 5.

Table 5:- Egg collection.

Age (weeks)	Conventional Separate Calcium Feeding	Innovative Separate Calcium Feeding
30	130	130
31	125	128
32	128	143
33	135	152
34	144	150
35	148	142
mind	**135 ± 9,21**	**140,83 ± 9,97**

Effect of separate calcium feed on egg production variables

The results obtained indicated that the innovative feeding improved egg number ($p<0.05$), laying These results are in agreement with previous work, notably by Picard et al (1993), Banga-Mboko, (1998), Bangamboko et al, (2007), The results may explain the the calcium intake was improved as indicated in table 4.

Conclusion:-

The aim of the experiment was evaluating response of laying hen to Innovative SCF meal in tropical areas. The results show ends an increase in egg number corresponding to in high calcium intake in laying of the Innovative SCF group. The hypothesis formulated at the beginning of the study is confirmed. The study suggests to distribute a diet with low calcium in the morning and calcium meal in the afternoon. The extension of such practice to the f local poultry is encouraged as an alternative in tropical poultry farming.

Conflicts Of Interest

The authors declare that they have no conflicts of interest.

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References:-

[1].Banga-Mboko, H., (1998). Etude des effets du mode d'apport du calcium alimentaire en relation avec la température sur les performances des lignées de poules pondeuses sélectionnées pour une faible et forte consommation alimentaire résiduelle. Mémoire de DESS en sciences vétérinaires tropicales, Université de Liège, Liège, Belgique, ,56p.

[2].Banga-Mboko H, A Bordas, F Minvielle and LeroyP.(2001). Effects of separate calcium feeding on laying hens selected for low (R–) or high (R+) residual feed consumption. AnimalResearche, 50(3): 239-250.

[3].Banga-Mboko,H., Bordas A., Minvielle F., Leroy P.L. (2003). Réponse à l'alimentation calcique séparée de poules pondeuse sélectionnées sur la consommation résiduelle. Annales de Médecine Vétérinaire, 147, 51-58.

[4].Banga-Mboko, H., Mabandza-Mbanza B., Adzona P., Batessana C., (2007). Réponse à l'alimentation calcique séparée de lignées commerciales de poules pondeuse Shaver dans les conditions tropicales du Congo Brazzaville. Bulletin of Animal Productionand Health in Africa, 55: 43 – 50.

[5].Mankpondji F. Houndonougbo, Christophe A. A. M. Chrysostome, Romaric C. Odoulami and Codjia J. T. C., (2012). Effect of the Delivery Mode of Snail and Oyster Shells on Laying Hens' Performance and Eggs Quality. Int J Appl Poult Res, 1(2): 55-58

[6].Mantsanga B. H., (2012). Effet d'une alimentation calcique séparée composée des matières premières locales sur les performances zootechniques de la poule pondeuse Isa Brown. Mémoire diplôme d'études approfondies (D.E.A) en bio écologie et productions animales. Université Marien Ngouabi, Brazzaville, Congo,46p.

[7].Mantsanga B.H., (2019). Effet du mode d'apport du calcium alimentaire sur les performances zootechniques de souches commerciales de volailles exotiques élevées en station et en milieu réel en climat tropical. Thèse pour l'obtention du doctorat unique en Sciences Biologiques, Option Croissance et Productions Animales.Université Marien NGOUABI, 150p.

[8].Mantsanga, B.H , I. Amona, H. Banga-Mboko, M. A. Bakana, P. P. Adzona(2016) Effet de l'alimentation calcique séparée sur les performances de production de la poule Lhoman Brown sous climat tropical humide. Journal of Applied Biosciences, 2016, Vol. 97, 9212-9219

[10].Mongin P., Sauveur B., (1979). The specific calcium appetite of the domestic fowl: In: Boorman K.N. and Freeman B.M. (éds) Food intake regulation in poultry. Edinburgh, pp: 171-189.

[11].Olver MD and DD Malan, (2000). The effect of choice feeding from 7 weeks of age on the production characteristics of laying hens. S Afr J AnimSci, 30(2): 110-114.

[12].Picard M., Antoine H., Sauveur B., (1993). Influence de l'alimentation calcique séparée sur l'ingéré énergétique de la poule pondeuse soumise à un stress thermique. Proc. VIII Europ.Poultry Conference. Paris, WPSA British. Fr. Edition. 1986. 406-411.

[13].Safaa HM, MP Serrano, DG Valencia, M Frikha, E Jiménez-Moreno and GG Mateos, (2008). Productive performance and egg quality of brown egg-laying hens in the late phase of production as influenced by level and source of calcium in the diet. PoultSci, 87: 2043-2051.

[14].Toli G., (2020). Aperçu sur le climat de Brazzaville entre la fin du XX^{e} siècle et le début du XXI^{e} siècle centre de recherche et d'étude sur l'environnement [En ligne] https//shs.hal.science/hal-03000336. Consulté le 11/08/2023

[15].Uzu G., (1989). L'alimentation de la poule pondeuse en climat chaud ; deux voies d'amélioration. L'aviculture, France, 504, 40-480,115-123.