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IMPACT OF MATERNAL EGG SIZE AND RESTRICTED FEEDING REGIME ON SOME GROWTH CHARACTERIZES OF BROILERS REARED UNDER HUMID TROPICAL ENVIRONMENT

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ABSTRACT: *The experiment was conducted to investigate the effect of different egg size from which birds are hatched have on their performance in terms of their growth traits and also to examine the effect of feeding regimen on the performance of Anak Titan broilers in a CRD study. The feeding regimes were ad- libitum (AL) and restricted feeding.(RF) The growth traits measured were feed intake (FI) body weight (BW), thigh length (TL), shank length (SL), breast length (BL) and body girth (BG) fortnightly. Efficiency of production was also evaluated using weight gain, feed conversion ratio, and mortality. Result showed that the egg size may affect the growth traits in that birds in group C (63-68g) with higher initial weight out performed that of B (58-62g) and A (50-57g), in terms of final body weight and most of the other growth parameters studied although there were no significant difference (P<0.05) between these three groups.. Body weights at 9th week for birds in A, B and C groups were 1386.59g, 1426.50g and 1521.05g respectively. The feeding regimes employed significantly (p<0.05) affected the performance of the broilers of combined egg size with the ad-libitum group being significantly (p<0.05) higher in values than birds on the restricted feeding group. There was no significant difference (P>0.05) in the interaction between birds of different egg size and feeding regimes. There was a high significant (p<0.05) correlation between body weight and all other growth traits throughout the study period. It is recommended that birds with egg weight range of 63-68g with high initial body weight and subsequent high performance under ad-libitum feeding should be adopted with occasioned restricted feeding to prevent wastage.*

ORIGINAL ARTICLE

Keywords: *egg size, feeding regimes, growth traits, broiler, humid tropics*

INTRODUCTION

According to Adeyinka et al. (2000), egg size is known to have a positive effect on growth and subsequent weight of domestic fowls. Walleman (1997) reported that the mean egg weight represent one of the most important factors governing the profitability of a laying enterprise, even small increase in egg weight can have significant effect on grading and hence economic returns. Thus, in the fowls, egg weight has been reported to determine the early growth of the chicks it produces.

Growth functions have been used extensively to represent changes in size with age, so that the genetic potential of animals for growth can be evaluated and nutritionally matched to possible growth (Lopez et al., 2000). Broiler production is totally dependent upon growth rate, market weight and total feed consumption. In order to achieve efficient poultry production and maximize profit, it is important to bring to the knowledge of the farmers the appropriate weight of broiler chicken at day-old hatched from a reasonable egg size that will give the required market weight at 8-10 weeks of age, under required quantity of feeding regimes and proper management.

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New development in management techniques is driven by the demand to improve the efficiency of broiler production. Primarily, breeders incorporates these broiler production goals like feed efficiency, low body fat and high breast meat yield into their selection programmes and feed formulation techniques to express fully the genetic potential of their stock (Middle Koop, 1997). According to Olomu (1995), for breeder stock, especially broiler breeder stock, some form of feed restriction is usually recommended. The most common management techniques consist of restricting the amount of feed per day. The practical application of this varies from limiting the period when broilers can eat to supplying limited amount of feed per day (Ramlah et al., 1996, Olomu, 1995, Casbel and Waldroup, 1990).

Ibe and Nwakalor (1987) observed that the relationship between body weight and conformation traits has an important implication in the production of broilers with desired body conformation. The exploitation of local poultry genetic resources for improving economic traits such as body weight, keel length, body depth, and breast width and shoulder length becomes one of the most important in poultry as a cherished breeding goal. (Oke et al., 2011) Growth in shank length, thigh length, and breast width has been found to have precisely followed the same trend as the body weight (Singh and Ohir, 1986, Nwachukwu et al., 2006) .Ayorinde and Oke (1995) noted that feed restriction is commonly applied to pullets to minimize mortality rates and ensure maximum production 0f settable eggs. The study was therefore conducted to determine the egg size for optimum broiler production and to determine the effect of feeding regime on the growth traits of broiler chicken at different ages.

MATERIALS AND METHODS

The experiment was conducted at the Poultry unit, Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria, located on latitude 05°29ᴵN and longitude 07°33ᴵeast. It is approximately 922m above sea level. Umudike has maximum and minimum daily temperature of 27-36o^{c} and 20-26o^{c} respectively with relative humidity of 57-91% and annual rainfall of2177mm.

A total of 500, one week old egg produced by meat type (Anak titan) breeder flocks were obtained from the farm, weighed and separated or marked into three different egg weights designated A (50-57g), B (58-62g), C (63-68g). The eggs were set in a Western type cabinet incubator. Incubation and hatchery conduction were 0-21 days, temperature of 37.2-39.4°c and relative humidity of 56-60% candling was done on the 7th and 18th day and only fertile eggs were transferred to the hatcher after the last candling. A total of 450 day-old chicks were produced from the three group of eggs weighed A, B and C respectively.

Management of experimental birds

The chicks were brooded for the first two weeks of life under continuous light thereafter they were raised on open-side deep litter. One hundred and ninety two birdsfrom each egg weight group was randomly assigned to two treatments of ad-libitum and restricted feeding (once a day feeding according to NRC, 1994), with 3 replicates per treatment of 32 birds each. The birds were fed commercial broiler starter diet containing 23% CP and 12.5 MJ ME/kg for 4 weeks and finisher diet of 20% CP and 12.5 MJ, ME/kg.

The birds were wing banded and body weight and all other body measurement taken fortnightly early in the morning before feeding the birds. Body weight was taken with a top-loading scale in grammes. All measurement of the legs was taken on the right leg in centimeter with a meter rule. Thigh lengths were measured from the beginning of the block joint to the last ring before the tarsemetatartasus digit. Breast length was taken from the point of the depression of the sharp edge (keel length). Body girth was taken in centimeter using a tape rule, the circumference of the animal posterior to the front leg. Feed intake was taken as the difference between the left over and the total feed presented measured in grammes with a scale. Weight gain calculated as final weight minus weight gain. Feed conversion ratio was calculated as gram feed over gramme weight gain, while mortality was taken as the number of dead birds over number of birds at housing multiplied by 100.

Experimental design and statistical analysis

The experiment was a 3X2 factorial involving 3 different egg size groups with two feeding regimes in a completely randomized design with the following model.

$Y_{ijk} = \mu + t_i + a_j + (ta)_{ij} + e_{ijk}$

Where

Y_{ijk} = individual observation on the birds

μ = overall mean

t_i = effect of the different egg weight

a_j = effect of the feeding regimes

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$(ta)_{ij}$ = interaction between different egg weight and feeding regime
E_{ijk} = experimental error (*iind*, o, σ)

Data collected were subjected to a two-way analysis of variance (Steel and Torrie, 1980). Correlation between body weight, feed intake, egg weight and different growth traits were determined using Pearson correlation Analysis (Snedecor and Cochran, 1989).

RESULTS

Results indicate no significant difference (P>0.05) between mean F1 in the three different egg sizes for week 3-7. Significant difference (p<0.05) were observed in week 9 and 11 with birds in group B and C being significantly (p<0.05) higher than A. There were no significant difference (p>0.05) in percent mortality for the different groups of birds throughout the experimental period with B group having lower percent values.

Table 1 - Effect of egg size on weight gain (WG), feed intake (FI), Feed conversion ratio (FCR) and mortality (MORT)

Age week	Egg size group	FI (g)	WG (g)	FCR	MORT (%)
3	A	479.50	315.91	1.62	0.50
		±43.06	±54.87	±0.329	±0.00
	B	498.80	317.14	1.60	0.00
		±46.76	±59.73	±0.188	±0.00
	C	500.70	330.73	1.55	0.50
		±44.64	±56.40	±0.258	±0.00
5	A	767.00	644.94	1.21	3.00
		±132.54	±113.14	±0.218	±1.727
	B	766.60	625.14	1.24	0.00
		±134.63	±114.06	±0.151	±0.00
	C	769.50	648.73	1.20	0.00
		±132.35	±119.97	±0.177	±0.00
7	A	1024.90	996.41	1.66	0.50
		±292.51	±119.10	±0.158	±0.00
	B	1130.00	1033.13	1.19	0.00
		±66.50	±256.19	±0.295	±0.00
	C	1151.50	1140.22	1.03	2.00
		±82.07	±214.72	±0.142	±1.727
9	A	1205.00[a]	1348.90	0.97	3.00[a]
		±116.65	±439.33	±0.245	±2.727
	B	1320.00[b]	1388.13	1.16	0.00
		±67.49	±441.57	±0.392	±0.00
	C	1297.80[b]	1479.23	0.90	0.50
		±57.09	±275.77	±0.155	±0.00
11	A	1406.50[a]	1727.91	0.90	0.00
		±126.94	±602.76	±0.292	±0.00
	B	14871.00[b]	1632.13	1.01	3.00
		±126.78	±500.03	±0.323	±2.00
	C	1476.70[b]	1898.22	0.79	1.00
		±167.68	±321.56	±0.125	±0.727

[a-c] means with different superscripts within the same column in each age group are significantly different (P<0.05)

Body weight was not significantly different (P>0.05) between the three egg size groups. The body weight of C (63-68g) was higher than that of A (50-57g) and B (58-62g) throughout the rearing period with 372.05g and 1521.00g for week 3 and 9 respectively. The thigh length (TL) of birds from the three different egg sizes show no significant difference (P>0.05). The shank length (SL) also of the birds did not differ significantly (P>0.05) with an average value 3.73cm and 5.96cm for week 3 and 7 respectively Breast length (BL) took the same pattern of other traits increasing with increase in age of birds with birds in group C having the highest value for all the weeks followed by A and B with no significant difference (P>0.05). The body girth at week 3 showed a significant difference (P<0.05) among the three egg weight groups with birds from egg weight group C, higher than those of A and B, this may be as a result of the high positive correlation between body weight and body girth.

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Table 2: Effect of egg size grouping on growth traits of broilers at 3-11 weeks of age						
Traits	**Egg size**	**3**	**5**	**7**	**9**	**11**
Body weight(g)	A	353.50	682.50	1034.00	1386.50	1765.50
	B	355.50	663.50	1071.50	1426.50	1670.50
	C	372.50	690.50	1182.00	1521.00	1940.00
	SEM	16.449	31.634	67.173	126.935	159.589
Thigh length(cm)	A	7.26	9.23	10.93	11.46	12.33
	B	7.23	9.22	11.03	11.60	12.28
	C	7.32	9.36	11.10	11.96	12.88
	SEM	0.155	0.171	0.233	0.243	0.303
Shank length(cm)	A	3.73	4.71	5.87	6.81	7.59
	B	3.59	4.69	5.96	6.83	7.59
	C	3.87	4.93	6.07	7.25	7.91
	SEM	0.093	0.104	0.120	0.180	0.223
Breast length(cm)	A	7.53	9.49	11.04	11.70	12.42
	B	7.42	9.41	11.13	12.00	12.39
	C	7.38	9.73	11.32	12.55	13.30
	SEM	0.184	0.194	0.231	0.283	0.331
Body girth (cm)	A	18.49[a]	23.24	25.92	28.08	31.04
	B	18.45[a]	22.80	25.28	29.13	30.79
	C	20.25[b]	23.05	26.35	30.08	32.72
	SEM	0.413	0.383	0.604	1.03	1.060

[a-c] means with different superscripts within the same column in each age group are significantly different (P<0.05)

There were no significant difference in feed intake for the various groups except in week 11 where the AF group of A, B and C were significantly different (p<0.05) from each other. Result also indicated no significant difference (P>0.05) between the interaction of the AF and RF groups of the three different egg weight in terms of FI for week 3-9. Weight gain of broilers were not significantly different, however, ad-libitum fed group had higher weight gain than the RF with values ranging from between 344.42-1160.42 (AF), 300.07-952.76g (RF) for week 3-7 respectively. FCR between treatment groups were not significantly (P>0.05) different. Mortality was low for birds in B group than in A and C. The average mortality was lower for RF groups .This is an indication that broilers on restricted feeding had lower mortality as compared to full-fed broilers.

Result indicate no significant difference (P>0.05) for all the parameters measured throughout the period except for the significant difference (p<0.05) which was observed in F1 in week 11 and body weight in week 3.

DISCUSSION

Table 1 shows the effect of egg weight grouping on feed intake (FI), weight gain (WG), feed conversion ratio (FCR), and mortality (MORT) of broilers at age 3-11 weeks. The mean values show increase in F1 with increase on age of birds, this may be because the bigger the birds the higher the feed requirement for growth and maintenance of their body size (Santoso, 2002, Oluyemi and Robert, 2000).The weight gain (WG) values for the three different groups were not significant (P>0.05) and followed the same trend with increase in age of the birds. This observation agree with the work of Oruseibo and Omu (2000) who noted that the weight gain of birds increase in proportion to the amount of feed consumed above that needed for body maintenance. The values of FCR were higher in week 3, 5 and 7 and declined thereafter till the end of the experiment. Smith (1970) had earlier confirmed that feed conversion ratio occurs at the earliest stages of growth and declines thereafter.

The mean value of body weight, thigh length, shank length, breast length and body girth for the three egg weight grouping are shown in Table 2. Birds hatched from larger eggs had higher BW, this agrees with the work of Adeyinka et al. (2000) and Latshaw and Bishop (2001). The thigh length (TL) of birds from the three different egg sizes show no significant difference (P>0.05). The shank length (SL) also of the birds did not differ significantly (P>0.05) with an average value 3.73cm and 5.96cm for week 3 and 7 respectively which was close to 3.6cm and 6.4cm obtained by Ibe and Nwachukwu (1989). Breast length (BL) took the same pattern of other traits increasing with increase in age of birds.

Table 3 shows the effect of feeding regimes, ad libitum (AF) and restricted feeding (RF) on feed intake (FI) weight gain (WG), feed conversion ratio (FCR) and mortality on broilers of three different egg weight groupings. Ad libitum fed

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group recorded highest feed intake than restricted group which agrees with the works of Ayorinde and Oke (1995) and Kamiaet al. (1996), which showed higher feed intake for chicken on ad-libitum feeding than those of RF groups.

The effect of egg weight grouping and feeding regimes on broiler feed intake, body weight, thigh length, shank length, breast length and body girth is shown in Table 4. Man et al. (1998) and Tina et al. (2004) reported that day-old chick with different weights begin to diverse in body weight from the end of week 3 of rearing. This is because when the birds are hatched, they still operate under the influence of maternal effect due to the presence of the yolk in them but at the end of week 3, this maternal is completely lost and they now exhibit individual characters or effect. This may account for the significant difference noted in week 3, which may assist animal breeders for broiler improvement through selection (Ibe 2007).

Table 3 - Effect of the different egg size grouping and feeding regime on the feed intake, weight gain, feed conversion ratio and mortality of broilers at ages 3-11 weeks.

Parameters	Ages (wks)	Egg size					
		A		B		C	
		AF	RF	AF	RF	AF	RF
Feed intake	3	537.00 ±15.508	485.00 ±5.523	540.60 ±23.006	457.00 ±4.69	543.00 ±2.915	458.400 ±1.140
	5	892.60 ±4.278	614.40 ±8.204	894.00 ±2.738	639.20 ±13.971	895.00 ±1.581	644.00 ±5.568
	7	950.00 ±45.906	1099.80 ±74.212	1164.40 ±30.680	1095.60 ±77.809	1200.20 ±59.213	1103.40 ±76.097
	9	1257.00 ±148.725	1153.00 ±417.07	1380.00 ±5.745	1257.00 ±17.161	1348.200 ±29.575	1247.40 ±10.406
	11	1523.00^{c} ±39.051	1290.00^{c} ±28.257	1596.00^{b} ±26.22	1366.00^{d} ±49.168	1634.40^{a} ±7.436	1319.00^{e} ±32.117
Weight gain	3	303.410 ±52.009	328.410 ±66.555	710.64 ±94.300	268.64 ±31.543	358.23 ±25.00	303.23 ±73.739
	5	690.41 ±125.193	599.41 ±105.629	1200.64 ±199.949	539.64 ±73.195	731.23 ±114.923	566.23 ±75.878
	7	1034.41 ±267.899	958.41 ±133.575	1515.64 ±299.236	865.64 ±232.309	1246.23 ±230.152	1034.23 ±184.945
	9	1525.41 ±549.688	1172.41 ±320.136	1783.64 ±250.040	1260.64 ±597.718	1652.23 ±260.513	1306.23 ±217.790
	11	2004.41 ±630.134	1451.41 ±565.778	1.469.34 ±0.137	1480.64 ±761.695	2088.23 ±185.742	1708.23 ±365.718
Feed conversion ratio	3	1.809^{a} ±0.259	1.44^{c} ±0.306	1.49^{b} ±0.137	1.72^{c} ±0.704	1.52^{b} ±0.102	1.58^{c} ±0.369
	5	1.32 ±0.215	1.09 ±0.166	1.27 ±0.165	1.19 ±0.143	1.24 ±0.203	1.15 ±0.154
	7	1.15^{a} ±0.218	1.16^{d} ±0.089	0.99^{b} ±0.0138	1.39^{c} ±.270	0.98^{b} ±0.161	1.07^{d} ±0.120
	9	0.90 ±0.281	1.03 ±0.215	1.14 ±0.352	1.17 ±0.469	0.83 ±0.117	0.97 ±0.163
	11	0.84 ±0.319	0.97 ±0.279	0.91 ±0.099	1.11 ±0.447	0.78 ±0.060	0.80 ±0.017
Mortality	3	0.50^{a} ±0.00	0.50^{a} ±0.00	0.00^{b} ±0.00	0.00^{b} ±0.00	0.50^{a} ±0.00	0.50^{a} ±0.00
	5	0.50 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00	0.00 ±0.00
	7	0.00^{c} ±0.00	0.50^{b} ±0.00	0.50^{b} ±0.00	0.00^{c} ±0.00	0.00^{c} ±0.00	5.00^{a} ±0.00
	9	7.00^{a} ±0.00	0.00^{c} ±0.00	0.00^{c} ±0.00	0.00^{c} ±0.00	0.50^{b} ±0.00	0.00^{c} ±0.00
	11	0.00^{c} ±0.00	0.00^{c} ±0.00	10.0^{a} ±0.00	5.00^{b} ±0.00	5.00^{b} ±0.00	5.00^{b} ±0.00

$^{a-c}$ means with different superscripts within the same column in each age group are significantly different ($P<0.05$). AF=Ad libitum feeding, RF=Restricted

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Table 4 - Effect of egg size grouping and feeding regime on feed intake, body weight, thigh length, shank length, and breast length and body girth

Parameters								
Egg size		A		B		C		
Feed type	Ages (WK)	AF	RF	AF	RF	AF	RF	SEM
Feed intake	3	53.700	458.00	540.00	457.00	543.00	458.00	5.27
	5	892.60	641.40	894.00	639.20	895.00	644.00	3.28
	7	950.00	1099.80	1164.40	1095.60	1200.20	1103.40	80.58
	9	1257.00	1153.00	1383.00	1257.00	1348.20	1247.40	28.97
	11	1523.00^{c}	1290.00^{e}	1596.00^{b}	1366.00^{d}	1634.40^{a}	1319.00^{e}	14.74
Body weight	3	341.00^{b}	366.00^{c}	404.00^{a}	307.00^{d}	400.00^{a}	345.00^{c}	23.26
	5	728.00	637.00	749.00	578.00	773.00	608.00	44.74
	7	1072.00	996.00	1239.00	904.00	1288.00	1076.00	94.98
	9	1563.00	1210.00	1554.00	1299.00	1694.00	1348.00	178.51
	11	2042.00	1489.00	1822.00	1519.00	2130.00	1750.00	225.69
Thigh length	3	7.22	7.30	7.26	7.20	7.38	7.26	0.22
	5	9.52	8.94	9.66	8.78	9.82	8.90	0.34
	7	10.94	10.92	11.44	10.62	11.40	10.80	0.33
	9	11.68	11.24	12.00	11.20	12.28	11.64	0.34
	11	12.82	11.84	12.66	11.90	13.24	12.52	0.43
Shank length	3	3.64	3.82	3.82	3.36	4.00	3.74	0.13
	5	4.90	4.52	5.00	4.38	5.18	4.68	0.15
	7	5.88	5.86	6.18	5.74	6.30	5.84	0.17
	9	7.04	6.58	7.18	6.48	7.40	7.10	0.25
	11	7.90	7.28	7.74	7.44	8.18	7.64	0.32
Breast length	3	7.32	7.74	7.48	7.36	7.56	7.00	0.26
	5	9.68	9.30	9.94	8.88	10.18	9.28	0.28
	7	11.04	11.04	11.62	10.64	11.60	11.04	0.33
	9	12.06	11.34	12.60	11.40	13.06	12.04	0.40
	11	13.00	11.84	12.88	11.90	14.20	12.40	0.47
Body girth	3	18.48	18.50	19.08	17.82	20.50	20.00	0.58
	5	23.40	23.08	23.82	21.78	23.86	22.24	0.54
	7	25.98	25.86	26.44	24.12	26.74	25.96	0.85
	9	28.62	27.54	30.02	28.24	31.52	28.64	1.46
	11	32.26	29.82	31.54	30.04	34.00	31.44	1.50

$^{a-e}$ means with different superscripts within the same column in each age group are significantly different ($p<0.05$). A, B and C = egg size grouping. AF = ad libitum feeding. RF = restricted feeding. SEM = standard error of mean

Table 5 - Correlation between body weight and linear body measurement of broilers of A (50g-57g) group at Ages 3-11 weeks

Bodyweight group		BW	TL	SL	BL	BG	FI
A	BW	1.000					
	TL	0.900**	1.000				
	SL	0.944**	0.969**	1.000			
	BL	0.920**	0.983**	0.977**	1.000		
	BG	0.935**	0.923**	0.942**	0.931**	1.000	
	FI	0.460	0.528	0.613	0.586	0.453	1.000
B	BW	1.000					
	TL	0.900**	1.000				
	SL	0.944***	0.969**	1.000			
	BL	0.920**	0.983**	0.977**	1.000		
	BG	0.935**	0.923**	0.942**	0.931**	1.000	
	FI	0.460	0.528	0.613	0.586	0.453	1.000
C	BW	1.000					
	TL	0.906**	1.000				
	SL	0.921**	0.951**	1.000			
	BL	0.965**	0.929**	0.934**	1.000		
	BG	0.878**	0.821**	0.875**	0.864**	1.000	
	FI	0.648*	0.522	0.464	0.706*	0.543	1.000

BW= Body weight, TL= Thigh length, SL= shank length, BL= Breast length, BG= body girth, FI= Feed intake. * P<0.05, ** P<0.01

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The correlation for the different growth traits including body weight and feed intake for the three different egg weight groupings, A-C, are shown in Tables 5. Correlation coefficients for the three egg weight grouping (A, B, C) were high and positive between body weight and each of the growth traits studied, supporting the observation by Ibe and Nwachukwu (1989) and Adeniji and Ayorinde (1990) that there exist high positive correlation between body weight and each of the correlated traits. According to Khan (2003), moderate to high estimate of heritability of 3rd week body weight together with high positive genetic correlation observed in this study suggest the need for selection for increased three week body weight required to achieve genetic improvement in market weight of broiler.

Correlation coefficients for the three egg weight grouping (A, B, C) were high and positive between body weight and each of the growth traits studied.

CONCLUSION

From the result of this study it can be noted that the different egg size from which the birds were hatched may impact on the performance of the birds and also quantity of feed given (AF and RF) had a direct influence on the performance of the birds irrespective of the egg weight on all the growth traits studied. Feed intake of birds increased with BW and with age of the birds. Birds with 63-68g egg weight had higher mean values for all the growth traits measured than birds with 58-62g and 50-57g and showed positive significant correlation between body weight and all the other body traits. It is therefore suggested that birds with higher initial body weight placed on AF like those in group C egg weight should be used for broiler production since they will give optimum production in the humid tropical environment.

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