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# STRAIN AND AGE EFFECTS ON GROWTH TRAITS IN BROILER CHICKENS

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**ABSTRACT**

Growth trait are quantitative traits influenced by both genetic and environmental factors. This study was carried out to investigate the effect of strain and age on growth traits of four different strains of broiler chicken. Four hundred (400) day old broiler chicks comprising of one hundred Cobb, Ross, Arbor acre and Marshall strains each, were purchased from reputable hatcheries and raised under the same management for a period of 10 weeks. Data collected on the growth traits were subjected to analysis of variance and Pearson correlation. Effect of strain was significant ($p<0.05$) on body weight at weeks 2 and 8, with highest values in Arbor acre (313.20 g) and Cobb (2012.80 g), respectively. Significant effect of strain on wing length was observed at weeks 2, 4 and 8, highest values were observed in Aboraca (10.50 g), Ross (13.60 g) and cobb (22.40 g). Wing span was affected by strain in weeks 2, 8 and 10 while breast girth, neck length and body length were significantly affected at weeks 2 and 8. Shank length was significantly affected at weeks 2 and 10 while beak length was affected at week 2. Significant effect ($p<0.05$) of age was observed in all the strains. Growth traits significantly increased from week 2 to week 10. The phenotypic correlations among the traits were positive and very highly significant ($p<0.00001$). It ranged, 0.857 to 0.977 (Marshal); 0.854 to 0.959 (Ross); 0.851 to 0.977 (Aboraca); 0.903 to 0.986 (Cobb). Strain and age had significant effect on growth traits and the traits are positively highly correlated in all the strains.

Keywords: growth traits, ross, Cobb, Arbor acre Marshal

## INTRODUCTION

In many developing countries of the world including Nigeria, the broiler industry plays a major role in supplying the population with meat which is highly nutritious and popularly consumed (Ukwu, 2004). The broiler chicken in Nigeria had served as the major source of protein for the population. Despite their economic importance, poultry production is affected by environmental factors among which include temperature, humidity and nutrition (Orunmuyi, 2006). Evaluation of performance of broiler strains is carried out using various indices, such as growth traits (body weight and body linear -measurement). Ebangi and Ibe (1994) reported that body linear measurements have heritable basis and have been identified to play a major role in the subsequent carcass yield of broiler strains. A range of techniques are available to gain information about broiler mass and body conformation. Some of these techniques use simple and inexpensive equipment, while others required sophisticated and expensive equipment (Kabir *et al*., 2010a). The most direct way to determine broiler's mass is to weigh it using digital weighing scale. However, under some circumstances, a scale may not be available. An alternative is to measure a body part and relate the measurement to the body weight. Shank length, thigh length, breast width are some body parts that are commonly measured and related to body weight in poultry ( Nwagu *et al.,* 2009; Kabir *et al.,* 2010b).

Over the years, the Nigerian poultry industry has witnessed the introduction of different broiler chicken strains (Ojedapo *et al*., 2016). Breeding and selection strategies can therefore be exploited to achieve the best in the poultry industry thus, selection for broiler strains that will reach market weight at reasonable age is important for profit maximization (Sam, 2019). Growth is a complex trait that is controlled by genetic and non- genetic factors (Udeh and Ogbu, 2011). According to Yakubu and Salako (2009), growth is a dynamic physiological process that exists from conception until maturity. Animal growth refers to an increase in body size, accumulation of adipose tissue during development from conception to maturity (Ajayi and Ejiofor, 2009). It also involves changes in functional capabilities of the various tissues and organs of animal (Adeleke *et al*., 2010). The growth performance is an important trait to be considered in meat type chicken. Growth is normally accompanied by an orderly sequence of maturational changes and involves accretion of protein and increase in length and size not just an increase in body weight. According to Ojedapo *et al*. (2016), there are several factors which affect the growth performance of broiler chickens and these include strain, sex, nutrition, housing and stocking density. Taha *et al*. (2010) reported the significant effect of chicken strain on growth rate and body weight at different ages. Body weight and linear body parameters of broilers are dependent on their genotypes (Atansuyi *et al*., 2017). There is evidence that there are genetic differences in growth rate between strain and changes in weight ranking may be critical in the age ranged between eight and twelve weeks (Deeb and Lamont, 2000). Low productivity experienced by broiler meat chicken producers in the tropics may be attributed to lack of selection of improved poultry breeds. Hitherto, little research work has been carried out on different improved breeds of broiler chickens by local producers, despite the fact that they are more numerous. There is need for research efforts to compare the performance of the various available and popular breeds of broilers with the aim of recommending the best to the farmers. However, Saki *et al*. (2010) reported no significant difference in body weight and growth rate of Cobb and Arbor acre strain raised in Iran. There are contradictory reports on the superiority of the most common strains of broilers (Cobb, Arbor acre and Marshall) with regards to their growth performance in Nigeria. Ojedapo *et al*. (2016) reported that Cobb broiler had higher body weight and body length throughout the growing period than Marshall strain. However, the report of Atansuyi *et al.* (2017) showed that Marshall broiler had the highest body weight among four genotypes of broilers studied. Udeh and Ogbu (2011) reported that Arbor acre had higher body weight than Marshall and other broiler strains at 8 weeks. This study was therefore designed to evaluate the growth traits of Marshall, Ross, Cobb and Arbor acre strains of broiler chicken at different ages.

## MATERIALS AND METHODS

### Experimental site

This study was conducted at Adeomoh Farms, which is about a kilometer to the Teaching and Research Farm of Olusegun Agagu University of Science and Technology, Okitipupa, Ondo State. Okitipupa lies between latitude $6^0$25 and $6^0$46 N and Longitude $4^0$35 and $4^0$50 E within the tropical rainforest zone of Nigeria.

### Experimental birds and management

Four hundred (400) day old broiler chicks comprising of one hundred Cobb, Ross, Arbor acre and Marshall strains each, were purchased from reputable hatcheries in Ibadan, Oyo State, Nigeria. The experimental pen was swept, cleaned, washed and disinfected prior to the arrival of the chicks. Adequate preparations were made for wood shaving, feeders, drinkers and brooding facilities. On arrival, the chicks were unboxed and stabilized in each experimental unit. Each strain represented a treatment. The experimental chicks were randomly allocated to four treatments according to the strains of the chicks in a completely randomized design. There were five replicates of 20 birds in each of the replicates. Feed and water were supplied *ad libitum* throughout the period of the experiment. All routine and occasional management practices were strictly adhered to and adequate health management practices observed during the period of the experiment. All necessary vaccinations/medications were administered accordingly. The experimental birds were fed with commercial feed and the study lasted for 10 weeks.

### Data collection

The body weight of bird was measured individually using a digital sensitive weighing scale. Breast girth was taken as the circumference of the breast round the deepest region of the breast using a measuring tape. Body length was measured as the distance between the base of the neck and the pygostyle with a measuring tape. The distance between the hock joint and the pelvic joint was measured as thigh length while wing length was taken as the distance between the point of attachment of wing to the body and tip of the wing using a measuring tape.

## RESULTS AND DISCUSSION

The effect of strain broiler on growth traits is shown in Table 1. At week 2, strain significantly affected ($p<0.05$) all the traits considered except shank length. Arbor acre had the highest body weight (313.20g), which is significantly higher than 229.80 g observed in Ross. This is contrary to the report of Fadare *et al* (2020) who reported that Cobb strain had the highest weight of 175.78 ± 2.51g at 2 weeks of age. However, Arbor acre , Mashall and Cobb had similar body weight at this age. No significant effect of strain was observed in body weight at weeks 4, 6 and 10. This is contrary to the reports of Fadare et al (2020) who reported significant effect of strain at week 4 and 6. The significant effect ($p<0.05$) of strain in the body weight observed at week 8 is similar to the report of Fadare et al (2020) and Amao et al (2015). Cobb had the highest body weight (2012.80) which is similar to that of Ross and Aboraca but significantly different to Marshall that had the least body weight (1475.60g).

Table 1: Effect of Strain on growth traits of broiler chicken

| AGE(wks) | STRAIN | BWT(g) | WL(cm) | WS(cm) | SL(cm) | BG(cm) | BL(cm) | NL(cm) | BKL(cm) |
|---|---|---|---|---|---|---|---|---|---|
| | Ab | $313.20^{a}$ | $10.50^{a}$ | $24.78^{a}$ | 3.38 | $15.52^{a}$ | $20.48^{a}$ | $4.32^{a}$ | $1.23^{a}$ |
| | MA | $265.80^{ab}$ | $10.30^{a}$ | $24.26^{a}$ | 3.50 | $14.78^{ab}$ | $20.54^{a}$ | $3.70^{ab}$ | $1.05^{b}$ |
| 2 | Cobb | $262.80^{ab}$ | $10.12^{a}$ | $23.74^{a}$ | 3.54 | $15.66^{a}$ | $19.08^{b}$ | $4.00^{a}$ | $0.98^{b}$ |
| | Ross | $229.80^{b}$ | $8.66^{b}$ | $22.20^{b}$ | 3.60 | $14.10^{b}$ | $19.70^{ab}$ | $3.10^{b}$ | $1.02^{b}$ |
| | SEM | 12.6 | 0.22 | 0.28 | 0.06 | 0.24 | 0.24 | 0.15 | 0.03 |
| | Ab | 619.80 | $10.50^{b}$ | 27.00 | $4.96^{a}$ | 22.20 | 26.84 | 5.54 | 1.40 |
| | MA | 553.40 | $13.14^{a}$ | 31.86 | $4.20^{b}$ | 21.00 | 25.64 | 5.70 | 1.48 |
| 4 | Cobb | 660.60 | $13.30^{a}$ | 31.54 | $4.50^{ab}$ | 22.60 | 26.38 | 5.83 | 1.53 |
| | Ross | 604.60 | $13.60^{a}$ | 30.80 | $4.38^{ab}$ | 21.30 | 25.52 | 5.52 | 1.52 |
| | SEM | 21.22 | 0.42 | 0.90 | 0.11 | 0.38 | 0.43 | 0.08 | 0.02 |
| | Ab | 1153.20 | 18.40 | 38.40 | 5.96 | 26.92 | 32.90 | 10.50 | 1.76 |
| | MA | 1350.60 | 17.80 | 39.30 | 6.00 | 26.50 | 3320 | 10.40 | 1.78 |
| 6 | Cobb | 1329.60 | 18.70 | 40.60 | 6.40 | 28.20 | 34.40 | 10.80 | 1.80 |
| | Ross | 1333.00 | 16.30 | 39.70 | 6.10 | 27.00 | 32.50 | 10.80 | 1.70 |
| | SEM | 47.56 | 0.49 | 0.43 | 0.08 | 0.34 | 0.37 | 0.21 | 0.03 |
| | Ab | $1791.20^{ab}$ | $22.00^{ab}$ | $46.20^{ab}$ | 8.6 | $31.80^{ab}$ | $40.20^{a}$ | $10.50^{b}$ | 2.00 |
| | MA | $1447.60^{b}$ | $20.80^{b}$ | $43.40^{b}$ | 8.5 | $29.00^{b}$ | $37.54^{b}$ | $11.50^{a}$ | 1.92 |
| 8 | Cobb | $2012.80^{a}$ | $22.40^{a}$ | $47.80^{a}$ | 9.20 | $32.80^{a}$ | $40.04^{a}$ | $11.40^{a}$ | 2.12 |
| | Ross | $1825.60^{a}$ | $21.50^{ab}$ | $44.80^{b}$ | 8.66 | $32.00^{ab}$ | $37.40^{b}$ | $11.40^{a}$ | 2.08 |
| | SEM | 67.49 | 0.26 | 0.57 | 0.20 | 0.56 | 0.43 | 0.16 | 0.03 |
| | Ab | 1962.50 | 22.50 | $46.50^{a}$ | $9.00^{a}$ | 33.00 | 40.50 | 13.00 | 2.20 |
| | MA | 1966.50 | 21.50 | $41.50^{b}$ | $8.25^{b}$ | 32.50 | 39.50 | 12.50 | 2.10 |
| 10 | Cobb | 2095.00 | 22.50 | $46.25^{a}$ | $9.00^{a}$ | 34.00 | 41.00 | 13.00 | 2.15 |
| | Ross | 2245.00 | 22.50 | $44.00^{ab}$ | $8.5^{ab}$ | 36.00 | 39.50 | 13.25 | 2.20 |
| | SEM | 66.84 | 0.53 | 0.81 | 0.13 | 0.61 | 0.29 | 0.15 | 0.04 |

a,b,c,d,e means with different superscripts on the same column are very significantly different ($p<0.0001$) BW-bodyweight;WL-wing length;WS-wing span; SL-shank length; BG-breast girth;BL-body length; BKL- beak length; NL- neck length; Ab- Arbor acre; MA- marshal

This result corroborated the findings of Amao *et al*. (2015) that the Cobb strain of broiler appeared to be superior to Marshall strain in terms of initial body weight. However, Fadare *et al* (2020) and Atansuyi *et al.* (2017) reported superiority of Marshal at this age over other strains. Gwaza *et al*. (2017) also reported that Marshall broiler strain had better growth than Arbor acre and Hubbard strain of broilers in the derived guinea savannah region of Nigeria. Ahmed *et al*. (2018) reported highly significant difference between Marshall and other strains of broiler chicken studied at 4 and 8 weeks. Generally, higher values were reported for body weights in this study compared with the reports of Fadare et al (2020). This could be attributed to differences in management. Strain had effect on wing length at weeks 2, 4, and 8. However no significant effect was observed in weeks 6 and 10, this is similar to observation of Fadare *et al* (2020) in weeks 2 and 4. Cobb had the highest wing length ( 22.40) at week 8 and this is similar to values observed in Aboraca (22.00) and Ross (21.50), however, significantly different ($p<0.05$) from Marshall (20.80). this is contrary to what was observed at week 2 in this study. Fadare *et al* (2020) observed lowest value for wing length at week 8. Strain had significant effect on wing span at weeks 2, 8 and 10. However no strain effect was observed at weeks 4 and 6. Highest values were observed in Aboraca (24.78), Cobb (47.80) and

Aboraca (46.50) respectively, at weeks 2, 8 and 10. Shank length was not affected by strain at weeks 2, 6 and 10. This is contrary to the report of Makka (2016) who reported highest shank length in Ross throughout the weeks of study. Aboraca had the highest shank length at week 4 which is contrary to Ross reported by Makka (2016). Significant effect of strain on breast girth was observed at weeks 2 and 8. This is in line with the reports of Fadare *et al* (2020), however Makka (2016) reported no significant effect of strain at week 2. The observations at weeks 4 , 6 and 10 in this study is in consonance with that of Fadare *et al* (2020). The non- significant effect of strain on body length observed in this study at weeks 4, 6 and 10 are in line with the report of Makka (2016) who reported same at week 6. Highest body length (20.54) was observed in Marshal at week2 in this study, while highest value was reported in Ross by Makka (2016). Aboraca had highest value (40.20) of body length at week 8, this is similar to the report of Makka (2016). Similar trend was observed in the effect of strain on body length, beak lenght and neck length, in this study. This could be attributed to the very highly positive correlation observed among them in this study.

Table 2: Effect of age on the growth performance of broiler chicken

| STRAIN | Age | BWT | WL | WS | SL | BG | BL | NL | BKL |
|---|---|---|---|---|---|---|---|---|---|
| | 2 | 313.20$^{a}$ | 10.50$^{c}$ | 24.78$^{c}$ | 3.38$^{d}$ | 15.52$^{d}$ | 20.48$^{d}$ | 4.32$^{d}$ | 1.23$^{c}$ |
| | 4 | 619.80$^{a}$ | 10.50$^{c}$ | 27.00$^{c}$ | 4.96$^{d}$ | 22.20$^{c}$ | 26.84$^{c}$ | 5.54$^{c}$ | 1.40$^{c}$ |
| AB | 6 | 1153.20$^{b}$ | 18.40$^{b}$ | 38.40$^{b}$ | 5.96$^{b}$ | 26.72$^{b}$ | 32.90$^{b}$ | 10.50$^{b}$ | 1.76$^{b}$ |
| | 8 | 1791.20$^{c}$ | 22.00 | 46.20$^{a}$ | 8.60$^{a}$ | 31.80 | 40.20$^{a}$ | 10.50$^{b}$ | 2.00$^{a}$ |
| | 10 | 1962.50$^{d}$ | 22.50 | 46.50$^{a}$ | 9.00$^{a}$ | 33.00 | 40.50$^{a}$ | 13.00$^{a}$ | 2.20$^{a}$ |
| SEM | | 134.57 | 1.18 | 2.01 | 0.45 | 1.39 | 1.67 | 0.69 | 0.07 |
| | 2 | 262.0$^{d}$ | 10.12$^{d}$ | 23.74$^{d}$ | 3.54$^{d}$ | 15.66$^{d}$ | 19.08$^{d}$ | 4.00$^{d}$ | 0.98$^{d}$ |
| | 4 | 660.6$^{c}$ | 13.30$^{c}$ | 31.54$^{c}$ | 4.50$^{c}$ | 22.60$^{c}$ | 26.38$^{c}$ | 5.82$^{c}$ | 1.52$^{c}$ |
| Cobb | 6 | 1329.6$^{b}$ | 18.70$^{b}$ | 40.60$^{b}$ | 6.40$^{b}$ | 28.20$^{b}$ | 34.40$^{b}$ | 10.80$^{b}$ | 1.80$^{b}$ |
| | 8 | 2012.8$^{a}$ | 22.40$^{a}$ | 46.25$^{a}$ | 9.00$^{a}$ | 32.80$^{a}$ | 40.04$^{a}$ | 11.40$^{b}$ | 2.12$^{a}$ |
| | 10 | 2095.0$^{a}$ | 22.50$^{a}$ | 47.80$^{a}$ | 9.20$^{a}$ | 34.00$^{a}$ | 41.00a | 13.00$^{a}$ | 2.15$^{a}$ |
| SEM | | 156.59 | 1.07 | 2.03 | 0.50 | 1.48 | 1.81 | 0.76 | 0.09 |
| | 2 | 265.8$^{c}$ | 10.30$^{d}$ | 24.26$^{d}$ | 3.50$^{c}$ | 14.78$^{d}$ | 20.54$^{d}$ | 3.7$^{e}$ | 1.05$^{d}$ |
| | 4 | 553.4$^{c}$ | 13.14$^{c}$ | 31.82$^{c}$ | 4.20$^{c}$ | 21.00$^{c}$ | 25.64$^{c}$ | 5.70$^{d}$ | 1.48$^{c}$ |
| Marshall | 6 | 1350.6$^{b}$ | 17.80$^{b}$ | 39.30$^{b}$ | 6.00$^{b}$ | 26.50$^{b}$ | 33.20$^{b}$ | 10.40$^{c}$ | 1.78$^{b}$ |
| | 8 | 1475.6$^{b}$ | 20.80$^{a}$ | 41.50$^{ab}$ | 8.25$^{a}$ | 29.00$^{b}$ | 37.54$^{a}$ | 11.50$^{b}$ | 1.92$^{b}$ |
| | 10 | 1966.5$^{a}$ | 21.50$^{a}$ | 43.40$^{a}$ | 8.50$^{a}$ | 32.50$^{a}$ | 39.50$^{a}$ | 12.50$^{a}$ | 2.10$^{a}$ |
| SEM | | 132.56 | 0.94 | 1.65 | 0.45 | 1.35 | 1.54 | 0.74 | 0.08 |
| | 2 | 229.80$^{e}$ | 8.66$^{c}$ | 22.20$^{d}$ | 3.60$^{c}$ | 14.10$^{e}$ | 19.70$^{d}$ | 3.10$^{d}$ | 1.02$^{d}$ |
| | 4 | 604.60$^{d}$ | 13.60$^{b}$ | 30.80$^{c}$ | 4.38$^{c}$ | 21.30$^{d}$ | 25.52$^{c}$ | 5.52$^{c}$ | 1.52$^{c}$ |
| Ross | 6 | 1333.0$^{c}$ | 16.30$^{b}$ | 39.70$^{b}$ | 6.10$^{b}$ | 27.00$^{c}$ | 32.50$^{b}$ | 10.80$^{b}$ | 1.70$^{b}$ |
| | 8 | 1825.60 | 21.50$^{a}$ | 44.0$^{a}$ | 8.50$^{a}$ | 32.00$^{b}$ | 37.40$^{a}$ | 11.40$^{b}$ | 2.08$^{a}$ |
| | 10 | 2245.0 | 22.50$^{a}$ | 44.80$^{a}$ | 8.66$^{a}$ | 36.00$^{a}$ | 39.50$^{a}$ | 13.25$^{a}$ | 2.20$^{a}$ |
| SEM | | 154.10 | 1.15 | 1.96 | 0.45 | 1.61 | 1.60 | 0.82 | 0.08 |

a,b,c,d,e means with different superscripts on the same column are very significantly different ($p<0.0001$) BW-bodyweight;WL-wing length;WS-wing span; SL-shank length; BG-breast girth;BL-body length; BKL- beak length; NL- neck length; Ab- Arbor acre; MA- marshal

Age had significant effect ($p<0.05$) on all the parameters considered in all the strains in this study as shown in Table 2. A progressive increase was observed from week 2 to week 10, this could be attributed to growth and developmental processes within the systems of the birds. This observation is similar to the reports of earlier researchers (Fadare *et al* (2020).

Table 3: Correlation coefficient in growth traits of Marshal and Ross

| | BW | WL | WS | SL | BG | BL | BKL | NL |
|---|---|---|---|---|---|---|---|---|
| BW | | 0.854*** | 0.919*** | 0.936*** | 0.968*** | 0.949*** | 0.943*** | 0.945*** |
| WL | 0.929*** | | 0.883*** | 0.911*** | 0.932*** | 0.919*** | 0.889*** | 0.884*** |
| WS | 0.869*** | 0.941*** | | 0.904*** | 0.951*** | 0.930*** | 0.933*** | 0.948*** |
| SL | 0.887*** | 0.960*** | 0.901*** | | 0.941*** | 0.943*** | 0.907*** | 0.906*** |
| BG | 0.920*** | 0.949*** | 0.925*** | 0.911*** | | 0.975*** | 0.964*** | 0.959*** |
| BL | 0.918*** | 0.977*** | 0.954*** | 0.946*** | 0.942*** | | 0.931*** | 0.958*** |
| BKL | 0.857*** | 0.931*** | 0.919*** | 0.859*** | 0.951*** | 0.953*** | | 0.912*** |
| NL | 0.947*** | 0.967*** | 0.932*** | 0.914*** | 0.934*** | 0.971*** | 0.937*** | |

BW-bodyweight;WL-wing length;WS-wing span; SL-shank length; BG-breast girth;BL-body length; BKL- beak length; NL- neck length; ($p<0.0001$)

Table 4: Correlation coefficient in growth trait of aboraca and cobb

| | BW | WL | WS | SL | BG | BL | BKL | NL |
|---|---|---|---|---|---|---|---|---|
| BW | | 0.981*** | 0.966*** | 0.976*** | 0.967*** | 0.977*** | 0.945*** | 0.947*** |
| WL | 0.941*** | | 0.980*** | 0.954*** | 0.967*** | 0.984*** | 0.969*** | 0.966*** |
| WS | 0.965*** | 0.973*** | | 0.953*** | 0.974*** | 0.986*** | 0.975*** | 0.948*** |
| SL | 0.973*** | 0.874*** | 0.924*** | | 0.940*** | 0.948*** | 0.925*** | 0.903*** |
| BG | 0.959*** | 0.875*** | 0.925*** | 0.961*** | | 0.987*** | 0.964*** | 0.944*** |
| BL | 0.969*** | 0.924*** | 0.969*** | 0.958*** | 0.977*** | | 0.976*** | 0.965*** |
| BKL | 0.934*** | 0.894*** | 0.909*** | 0.868*** | 0.893*** | 0.908*** | | 0.937*** |
| NL | 0.894*** | 0.892*** | 0.897*** | 0.851*** | 0.899*** | 0.894*** | 0.898*** | |

BW-bodyweight;WL-wing length;WS-wing span; SL-shank length; BG-breast girth;BL-body length; BKL- beak length; NL- neck length; ($p<0.0001$)

Table 3 shows the phenotypic correlations among the growth traits. The upper diagonal is for Ross, the correlations were positive, very highly significant and ranged between 0.883 and 0.975. The lower diagonal represents Marshal, correlations were positive, very highly significant and ranged between 0.857 and 0.977. The observed relationships are similar to the reports of Makka (2016). The correlations among the growth traits in Aboraca and Cobb are shown in Table 4. The lower diagonal is Aboraca, and it ranged between 0.851 to 0.977. While the upper diagonal is Cobb, and ranged between 0.903 to 0.986.

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