

INFLUENCE OF ECONOMIC PARAMETERS AND SEASON ON BROILER PERFORMANCE EFFICIENCY FACTOR (BPEF) IN COMMERCIAL FARMING

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ABSTRACT

Analysis of performance of industrial broiler chicken data reveals that, summer season has recorded significantly ($P < 0.01$) higher market age of 39.98 days and the highest market weight was recorded in winter (2.33 kg). The lowest market weight was recorded in summer (2.20 kg) with significantly ($P < 0.01$) poorest feed conversion ratio of 1.70. The high negative correlation coefficient of -0.88 was observed between feed conversion ratio and Broiler Performance Efficiency Factor (BPEF) score which indicates that, feed efficiency is a single largest factor influencing the BPEF score, while market age has the positive correlation with feed conversion ratio (0.63), which means market age has negative association with feed efficiency. It is concluded that, though feed efficiency is a single largest factor in influencing the BPEF score, while market age is indirectly influencing feed efficiency which in turn is a decision of integrator.

Keywords : BPEF, Feed Efficiency, Broiler Chicken

Received : 01.04.2024

Revised : 17.05.2024

Accepted : 26.11.2024

INTRODUCTION

Commercial broiler chicken farming of India is almost integrated from breeder to commercial broiler chicken production and marketing. The two critical stake holders of the broiler chicken production are integrator and contract grower. Integrator is a person

who is integrating all the production activities from parent breeder management to processing and marketing of broiler chicken meat, whereas contract grower looks after the growing of broiler chicken on contract basis. In the view of both the stake holders, market age, market body weight, feed efficiency and livability of broiler chicken are considered as the critical economic traits, which decide the profitability of integrator per batch and income for contract growers for rearing a batch of broilers up to market age (North and Bell, 1994 and Iqbal *et al.*, 2012).

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Comparing batch wise performance of broiler chicken based on any one of the above traits will not offer clear idea about the overall performance of the batch, because these traits are closely interlinked and they are positively or negatively correlated. Market age is negatively correlated with feed efficiency and at the same time it is positively correlated with market weight. On the other hand, though the trait of market age has the chance for negative correlation with livability, quality feed and management, climate stress, good bio-security in the maintenance of health of the birds are the other important factors.

In this context, Broiler Performance Efficiency Factor (BPEF) otherwise called Production Efficiency Factor (PEF) or European Production Efficiency Factor (EPEF) is a holistic metric in evaluating the performance of batch of broiler chicken (Shane, 2008 and Kryeziu *et al.*, 2018). BPEF is a function of four critical traits namely market age, market body weight, feed efficiency and livability which offer a single value for an easy comparison of batch wise broiler chicken performance. BPEF facilitates the comparison of performance within and among farms and can be used to assess environmental, climatic and managerial variables effect on performance. Since, BPEF incorporates terminal market weight, age and feed efficiency (growth functions) along with livability (health function), any adverse or beneficial effect relating to health, environmental stress or feed quality will be reflected in the BPEF score (Shane, 2008).

Due to its advantages of wholesomeness in evaluation, integrators are also using this measure for their regular strain, batch, and region wise comparative analysis.

Though, there are number of literatures available on economic performance of broiler chicken, literature on the application of BPEF is very scanty. Considering that, this study is designed to evaluate the application of BPEF with reference to critical economic traits and season by using industrial data of commercial broiler chicken farming system.

MATERIALS AND METHODS

Data of a total of 348 batches of varying flock sizes of broiler chicken were collected from the industry for a period of one year from 1st January 2023 to 31st December 2023. Data were collected randomly from various intensive broiler chicken rearing regions namely, Trichy, Perundurai, Vellore and Krishnagiri taluks of Tamil Nadu. From the above data, batch wise flock size (number of DoC stocked at the start), market age, market weight, feed efficiency up to market age and livability were worked out and the same were grouped season wise based on the date of lifting the birds to market. Summer, monsoon and winter season comprised of the batches lifted in the months of April-May, October-November and December - January respectively.

Based on the above data, batch wise BPEF was worked out by the following model,

$$\text{BPEF} = \frac{\text{Mean market weight (kg)} \times \text{Livability (\%)} \times 100}{\text{Mean market age (days)} \times \text{Feed Conversion Ratio}}$$

- 1) Mean market weight : Total live weight output of a particular batch at the time of lifting divided by number of live birds output of that batch
- 2) Livability: 100 minus per cent mortality of a particular batch in its growing period
- 3) Mean market age: Grow out period (from day of stocking of day - old chick to day of lifting the birds for market)
- 4) Feed Conversion Ratio: Batch feed conversion ratio was worked by dividing total feed intake of a batch by its total live weight output

Season wise batch flock size, mean market age, market weight, livability, feed efficiency and BPEF score were worked out and the same was subjected for descriptive statistics and test of significance statistical analysis by using One Way ANOVA model (Snedecor and Cochran, 1989). Pearson's rank correlation coefficient was worked out for all the traits in all possible combinations to elucidate the influence of individual trait on another and on BPEF. The statistical analysis was conducted in Statistical Packages for Social Sciences software (SPSS 2.0) with proper data layout.

RESULTS AND DISCUSSION

The mean season wise performance of commercial broiler in critical economic traits of market age, market weight, feed efficiency and livability and mean Broiler Performance Efficiency Score of batches

are presented in Table 1. Pearson's rank correlation coefficient among the critical economic traits and with BPEF score are presented in Table 2.

Market age

The mean market age is 39.98, 38.73 and 38.44 days for summer, monsoon and winter seasons respectively. Summer season has recorded significant ($P < 0.01$) higher market age of 39.98 days, than the other two seasons. Though, the growth is a genetic function and the desirable market age of commercial broiler is almost standardized around 42 days, the exact market age or lifting age of a batch of broiler chicken for market in integration is fixed by integrator based on the market demand of broiler chicken on daily basis in the respective season. The mean market age reported for Indian broiler production for Tamil Nadu region was 41.17 days in

hot seasons (Murugan and Raghavan, 2018) for 221 batches of commercial broilers in integration. The reason for the numerically lower values reported in this study could be attributed to genetic improvement of the stock over the time and seasonal variation in market demand between the two studies.

Market weight

The mean market weight of broiler chicken for summer, monsoon and winter were 2.20, 2.25 and 2.33 kg, respectively. The highest market weight was recorded in winter, followed by monsoon and summer and the difference was also statistically significant ($P < 0.01$). The lowest market weight was recorded in summer (2.20 kg) with significantly ($P < 0.01$) highest market age of 39.98 days, and reasons are obvious. It is in accordance of the findings of Akyuz, (2009) and Benyi *et al.*, (2015) who found that summer has significant negative influence on market weight of broiler chicken due to dip in feed intake out of heat stress. On the other hand, although, monsoon and winter did not show any statistical significance in its mean market age, winter recorded significantly ($P < 0.01$) higher market weight of 2.33 kg, which is higher than monsoon season and the reason may be winter is more conducive climate profile for broiler chicken's growth performance.

Feed Conversion Ratio (FCR)

The mean feed conversion ratio values of summer, monsoon and winter batches of broilers are 1.70, 1.58 and 1.60 respectively. Interestingly, summer has recorded significantly ($P < 0.01$) poorest feed conversion ratio of 1.70 followed by winter

and monsoon. However, the difference of feed conversion ratio between monsoon and winter was not statistically significant like their market age. The significant ($P < 0.01$) poor feed efficiency of summer can be easily attributed to the negative impact of acute heat stress of the inland locations (Trichy, Perundurai, Vellore and Krishnagiri of Tamil Nadu) on growth of broiler chicken.

Livability

The mean livability of batches of broilers in summer, monsoon and winter were 95.16, 95.86 and 95.08 per cent respectively with the overall mean livability of 95.41 per cent and monsoon season has recorded significantly ($P < 0.01$) higher livability than summer and winter. The expected livability in commercial broiler farm during grow out period of 39 days will be 95 per cent and in other way, accepted mortality is less than five per cent. However relatively lower livability value of 94.02 per cent (Murugan and Raghavan, 2018) was reported in earlier study in commercial broiler integration farming system.

Flock size

Mean flock size of various batches of broiler chicken in summer, monsoon and winter seasons are 4624.56, 4600.55 and 5028.60 respectively. Though, there are numerical differences in flock sizes among seasons, it is not statistically significant. However, based on the Coefficient of Variation of data set, the flock size is having variation to the tune of 46.56 in overall. Similar values of 5947 birds with CV of 46.82 per cent were reported earlier in integrated farming systems of Tamil Nadu.

(Murugan and Raghavan, 2018). It clearly indicates the wide variation in the flock sizes of contract grower farms in broiler integration. This reveals the fact that, unlike layer farms, still contract growing in broilers remains as supportive subsidiary for small and marginal agriculture farmers.

Broiler Performance Efficiency Factor (BPEF)

The mean BPEF score for summer, monsoon and winter are 309.35, 353.04 and 362.69 respectively. The reported values were lesser than the values reported 412.62 with 2.86 kg body weight and 1.67 feed conversion ratio in Brazil for experimental bird (Martins *et al.*, 2016). Summer recorded significantly ($P < 0.01$) lowest BPEF score of 309.35, and monsoon and winter have not recorded any significant difference in BPEF score between them, although there was numerical difference. In the same line, the reported value of BPEF score for cold and hot zones of Tamil Nadu were 306.39 and 276.17 respectively (Murugan and Raghavan, 2017). The variation could be attributed to the genetic improvement of the commercial strain and the environmental factors between these studies. They attributed the difference in BPEF between hot and cold zones to market age, high market body weight; high feed efficiency and better livability in cold zones when compared to hot zones.

The overall mean market age, market weight, feed conversion ratio, livability, Broiler Performance Efficiency Ratio and flock sizes in the current study were 39.06 days, 2.26 kg, 1.63, 95.41 per cent, 341.32 and 4729.03 respectively.

Influence of economic traits on BPEF

BPEF score is an index of four variables namely market age, market weight, feed efficiency and livability. In this index, market weight and livability are expected to affect the score positively while market age and feed conversion ratio will affect negatively, and the degree of influences is based on the correlation between these traits and BPEF score. Moreover, market age and market weight, market age and feed conversion ratio, market weight and feed conversion ratio are also interlinked (Martins *et al.*, 2016).

Pearson correlation coefficient of market age and market weight is 0.56, and the traits are positively correlated and demonstrated that, as the market age increases, market weight may also increase. Market age and feed conversion ratio has positive correlation coefficient of 0.63, which indicated that as the market age advances, over all feed efficiency of the batch reduces with poor feed conversion ratio values.

Market age and livability had the negative correlation of -0.21 and indicated that as the age advances the probability of mortality is also high. The correlation coefficient of -0.42 was observed between market age and BPEF score, which clearly established negative association between these two traits. The correlation between market age and flock size was -0.09, the magnitude of which is not significant to draw any conclusion.

The correlation between market weight and BPEF score is positive to the tune of 0.46, it is in accordance with the inbuilt model of BPEF score. The market weight and feed efficiency correlated negatively with the correlation coefficient of -0.1. The correlation between market weight and livability is positive (0.04), whereas, that of market weight and flock size is negative (-0.08) and both are insignificant to draw any valid conclusion.

The high negative correlation coefficient of -0.88 was observed between feed conversion ratio values (FCR) and BPEF score and it clearly indicated that, feed efficiency is a single largest factor among the critical economic traits, influencing the BPEF score. At the same time, market age has the positive correlation with feed conversion ratio values (0.63), which means market age has negative correlation with feed efficiency in true sense. Based on these observations, it can be concluded that, though feed efficiency is a single large factor in influencing the BPEF score, market age is indirectly influencing feed efficiency but, market age is mostly determined by the integrator based on market demand and it is a decision of integrator and not of the contract grower.

In contract growing process, the growing charges (per kg live weight of broiler chicken) is primarily fixed by the feed efficiency per unit live weight. But, based on the analysis of this data, it is noted that, feed efficiency has substantial negative influence by market age, fixing the market age is not in the hands of contract grower and it is a function of daily market demand and integrator as whole. However, certain companies are arriving contract growing charges based on the corrected feed conversion ratio values, in which feed conversion values are calculated for a fixed live market body weight of 2 kg, which benefits the farmers by offsetting the variability in the market age. Livability is also having a correlation of 0.44 with BPEF score, slightly negatively influenced by market age. Considering these factors, suitable models involving BPEF need to be developed for fixing the growing charges per unit live weight of broiler chicken.

ACKNOWLEDGEMENT

The authors sincerely express their thanks to Krishi Nutrition Company Private Limited, Perundurai, Tamil Nadu for sharing their data for this study.

Table 1. Mean performance of critical economic traits of commercial broiler chicken and Broiler Performance Efficiency Factor Score

Name of the trait	Season			Over all (N = 348)
	Summer (N=115)	Monsoon (N=135)	Winter (N = 98)	
Market age (days)**	39.98 ^a ± 0.20 [5.22]	38.73 ^b ± 0.20 [6.06]	38.44 ^b ± 0.22 [5.61]	39.06 ± 0.12 [5.89]
Market weight (kg)**	2.20 ^a ± 0.01 [7.44]	2.25 ^b ± 0.02 [7.89]	2.33 ^b ± 0.02 [9.20]	2.26 ± 0.01 [8.40]
Feed Conversion Ratio **	1.70 ^a ± 0.01 [6.50]	1.58 ^b ± 0.01 [4.48]	1.60 ^b ± 0.01 [4.28]	1.63 ± 0.01 [6.24]
Livability (%)	95.16 ^a ± 0.15 [1.66]	95.86 ^b ± 0.10 [1.10]	95.08 ^b ± 0.18 [1.86]	95.41 ± 0.08 [1.60]
BPEF **	309.35 ^a ± 3.43 [11.83]	353.04 ^b ± 2.78 [9.11]	362.69 ^b ± 3.81 [10.35]	341.32 ± 2.25 [12.27]
Flock size NS	4624.56 ^a ± 202.58 [46.77]	4600.55 ^b ± 180.33 [45.37]	5028.60 ^b ± 242.232 [47.46]	4729.03 ± 118.19 [46.56]

** The mean values bearing different superscripts in a row differ significantly (P<0.01), NS- Not Significant. Values in the square brackets indicates the Coefficient of Variation in per cent

Table 2. Pearson's Correlation coefficients among the critical economic traits of commercial broiler chicken and Broiler Performance Efficiency Factor Score

Traits	Market age	Market weight	FCR	Livability	BPEF	Flock Size
Market age	x	0.56	0.63	-0.21	-0.42	-0.09
Market weight	x	x	-0.10	0.04	0.46	-0.08
FCR	x	x	x	-0.39	-0.88	0.00
Livability	x	x	x	x	0.44	0.00
BPEF	x	x	x	x	x	-0.01
Flock Size	x	x	x	x	x	x

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