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# Effect of linear and random non-linear Programming feed formulating on performance of broilers

**Sharifeh Ghavidel Heydari**

Dept. of Animal Science, University of Zabol

***Corresponding author*:** Sharifeh Ghavidel Heydari

**ABSTRACT:** Linear programming is a useful and common method in feed formulating based on minimum cost. However, minimum cost does not mean maximum profit. The aim of this study was to provide a new method of feed formulating that consider the maximum profit instead of minimizing the cost of ration. Thus, 300 Ross 308 broilers were divided into five treatments with four replicates and 15 birds in each replicate. Experiment was carried out during starter, grower and finisher periods. Experimental dietary treatments in each period were including linear programming (LP50, LP69) and random non-linear programming diets (SP69, SP95, SP99 percent). Experimental data were subjected to analysis of variance based on completely randomized design and means were compared by Duncan،s multiple range test. The results showed that rations formulated with random non-linear program had significant effect on feed intake and feed conversion ratio. In addition, reduced abdominal fat and increased breast weight significantly.

***Keywords*:** Diet, feed formulation, Maximum profit, Nutrient density.

## INTRODUCTION

There have been many applications and software in order to set poultries' diets which are based on the linear programming in order to minimize their costs. Linear diet formulation only reduces the cost of each unit of food for supplying feeding requirements based on the average amount for each nutrient and due to the fact that each nutrient is likely to fulfill the requirements 50%, the risk of failure to meet the needs and non- maximization of profit rises ( 4 ). Since the growth response of broilers to different levels of nutrient intake is non-linear, it is important to increase the confidence coefficient of each nutrient with respect to the variance of each nutrient. However, in some cases maximizing growth will not guarantee the maximum profit. Therefore, instead of focusing on the maximum biological function it is better to consider the maximum economic yield (9). In this regard, Rush . (1995) argued that Stochastic linear programming is able to provide the bird's need and optimal performance which is better than linear programming through considering the variance of the nutrients. The purpose of this study was to analyze and compare the effect of non-linear diet formulation with linear programming on the performance of broilers.

## MATERIALS AND METHODS

300 1 day old chicks Ross 308 chicks were purchased. For each test phase, which includes the Starter, grower and finisher phases, 5 different diets ( LP50 , LP69 , SP69 ,SP95 And SP99 ) were prepared. The experimental diets were formulized using two methods of linear and nonlinear programming.

### *Linear Programming (LP)*

Due to the fact in a particular aviculture system the cost of livestock feed are the major part of the costs, thus the linear programming method can be used to minimize the cost of livestock feed (3). Satisfying the nutritional needs of animals are the main constraints of linear programming (1). Typically this method is used to maximize the profit or return or in order to minimize the cost of a unit of production.

***Mathematical model of linear programming***

The model used for linear programming is as follows: (10)
The objective function

$$Minimise \sum_{j-1}^{n} c_j x_j \rightarrow (j = 1, 2, 3, \ldots\ldots n)$$

Limitations

$$\sum_{j-1}^{n} a_{ij} x_j \geq b_i$$

Where:
$C_j$: indicates the objective function coefficients (cost of food)
$a_{ij}$:Coefficients technique of linear programming model(different combinations of food)
bi: The limitation that includes essential requirements of poultries.
X j : Represents the number of food in the objective function.
In the Stochastic programming if the user wants to change the jth nutrient to a higher or lower level than $b_i$ P>Ø . thus the following limit is set.

$$P\left(\sum_{j-1}^{n} a_{ij} x_j \leq b_i\right) \geq \varphi_i$$

In linear programming it is assumed that the input variables (levels of nutrients, animal needs and price elements) have a linear trend and are well known. But since the variance of the dietary nutrients are the square of the standard deviation [variance = $(SD)^2$], dietary programming becomes a non-linear problem. Thus, since the variability of the nutrients is an non linear input, the linear program is violated (2). Since the violation of certain assumptions in LP cause some problems in diet formulation, it is better to use a non-linear model (12). Nowadays the nonlinear program “STCH " is considered a more appropriate tool in the variability in nutrients in diet formulation (6). It sets the margin of safety for diet formulation and considering the diversity of dietary nutrients at different stages of diet formulation provides the animal's requirements with certainity about the amount supplied (13).

***Statistical Analysis***

This experiment was performed as a completely stochastic design with 5 experimental groups with 4 replications. Thus chicks were distributed in 20 cages and each cage contained 15 broilers. Increase in body weight, feed intake and feed conversion coefficient was analyzed by SAS software using the GLM method weekly.

## RESULTS AND DISCUSSION

The results indicated that in the starter phase there was a higher sensitivity to the diet formulation and the Stochastic formulation methods cause an increase in weight At an early age rather than the linear adding of margin of safety(Figure 1). During the grower phase the birds responded to the new formulation method and the increase in body weight was significantly more than other treatments with a probability level of 69% and 95% ($p<0.05$) using the Stochastic method. Findings of the research were in line with Rush ., 1996.

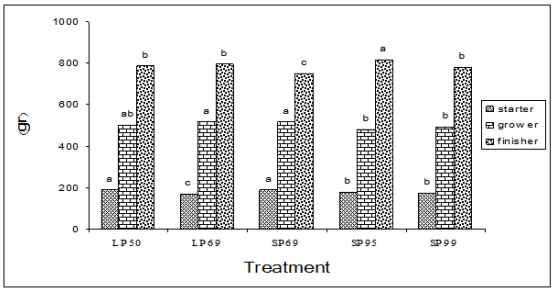


Figure 1. Mean weight gain in different treatments during the growing period (g)

Using the Stochastic formulation and increasing the probability thefood intake was significantlyreduced ($p<0.05$) (Figure 2). Stochastic formulation method for providing protein and amino acid needs of the birds has higher accuracy ( 8 ).

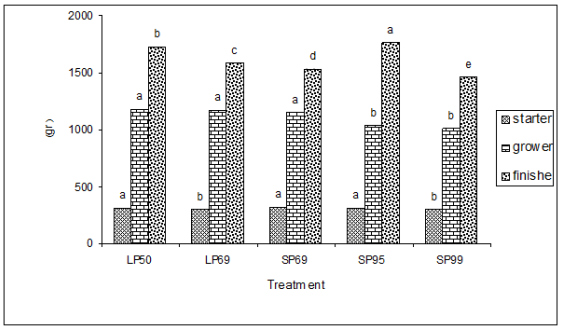


Figure 2. Different levels of food intake during the grower period (g)

It is observed that by changing the linear method of diet formulation into the Stochastic method, the food conversion coefficient is improved (Figure 3) although in some treatments this improvement in performance was not statistically significant. This reflects the accurate satisfaction of the bird's needs by Stochastic methods. Begay . (2009) reported that the lack of a balanced diets leads to increased production costs, reduced growth and feed efficiency.

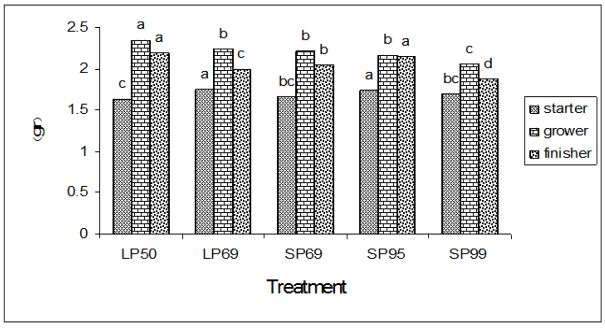


Figure 3. Mean FCR (feed conversion ratio ) of different treatments during the finisher period

***Conclusion***

Linear programming is a cost effective and regular method in diet formulation based on the least cost, but the minimum cost, does not necessarily provide the maximum profit.Diets based on maximum profit using Stochastic nonlinear programming can be an effective method in diet formulation in and significantly reduce feed intake and improved the FCR (feed conversion ratio).

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