Evaluation of dietary beta-agonist on production performance and carcass of beef cattle: a meta-analysis

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Abstract. This study aimed to evaluate the use of beta-agonist on beef cattle by integrating data from various experiments and analyzing the data by a meta-analysis method. A total of 42 articles were used to build a database in which the articles reported dietary addition of beta-agonist on performance and carcass of beef cattle. Treatments were grouped into control (without beta-agonist) and with beta-agonist addition. The treatments were considered as fixed effects whereas different experiments were considered as random effects. Model statistics used was P-value in order to distinguish between the two groups, and the P-value less than 0.05 was considered to be significant. Results showed that dietary beta-agonist addition increased average daily gain and gain to feed ratio of beef cattle ($P<0.001$). Beta-agonist elevated hot carcass weight ($P<0.001$) and dressing percentage ($P<0.01$), but had no effect on fat thickness. Longissimus muscle area increased ($P<0.001$) while marbling score decreased ($P<0.05$) due to the addition of beta-agonist. The additive positively influenced Warner-Bratzler shear force of carcass ($P<0.001$) but had no effect on its pH value. In conclusion, beta-agonist favourably affects production performance and carcass property of beef cattle.

1. Introduction

Improvement of beef cattle production in feedlot may be achieved by providing the animals a balance diet with regard to its nutritional composition such as energy, protein, vitamin and mineral. Certain feed supplements or feed additives may also be added for further optimizing the production performance as well as the carcass characteristics. A number of ionophores such as monensin, lasalocid and salinomycin have been used in feedlot to enhance beef cattle performance [1-3]. Natural bioactive compounds originated from plants such as tannin, saponin and essential oils have also been tested as feed additives for beef cattle, both in the *in vitro* and *in vivo* experiments [4-6].

Another class of feed additive that is potent to use for such purpose is beta-agonist. Beta-agonist is a non-hormonal substance that binds to fat receptors on fat cells and reduces the metabolism of fat. It also binds to receptors on muscle cells and increases the size of muscle fibers [7]. The most common beta-agonist fed to cattle is ractopamine and zilpaterol [8,9]. Despite its common use, to date there is lack of study to quantitatively summarize the effect of beta-agonist across different studies. This study therefore aimed to evaluate the use of beta-agonist on beef cattle by integrating data from various experiments and analyzing the data by a meta-analysis method.

2. Materials and methods

A database was constructed from literatures reporting the addition of beta-agonist into diets of beef cattle. Electronic databases used for literature searching were Scopus, Science Direct and Google Scholar. After evaluating the title, abstract and full text of potential literatures, a total of 42 articles were used to build the database. Treatments were grouped into control (without beta-agonist) and with beta-agonist addition. Parameters included in the database were focused on performance and carcass of beef cattle. These parameters were feed intake, daily weight gain, gain to feed ratio, hot carcass weight, carcass percentage, fat thickness, longissimus muscle area, marbling score, Warner-Bratzler shear force of carcass and pH.

Data were analyzed according to the mixed model methodology [10]. The treatments were considered as fixed effects whereas different experiments were considered as random effects. Model statistics used was P-value in order to distinguish between the two groups, and the P-value less than 0.05 was considered to be significant. Data analysis was performed by using SAS software version 9.1 and employed PROC MIXED.

3. Results and discussion

Effects of dietary beta-agonist addition on production performance of beef cattle are presented in Table 1. Dietary beta-agonist addition increased final body weight and average daily gain of beef cattle (P<0.001), while it had no effect on dry matter intake. As a consequence, the additive elevated gain to feed ratio of beef cattle (P<0.001; Figure 1).

Table 1. Effects of dietary beta-agonist addition on production performance of beef cattle

Parameter	Unit	Control	Beta-agonist	Significance
Initial BW	Kg	449±13.9	449±13.9	ns
Final BW	Kg	579±7.23	587±7.22	***
DM intake	kg/d	9.97±0.240	9.90±0.240	ns
ADG	kg/d	1.48±0.044	1.64±0.043	***

BW, body weight; DM, dry matter; ADG, average daily gain; ns, non-signifinance; ***, P<0.001.

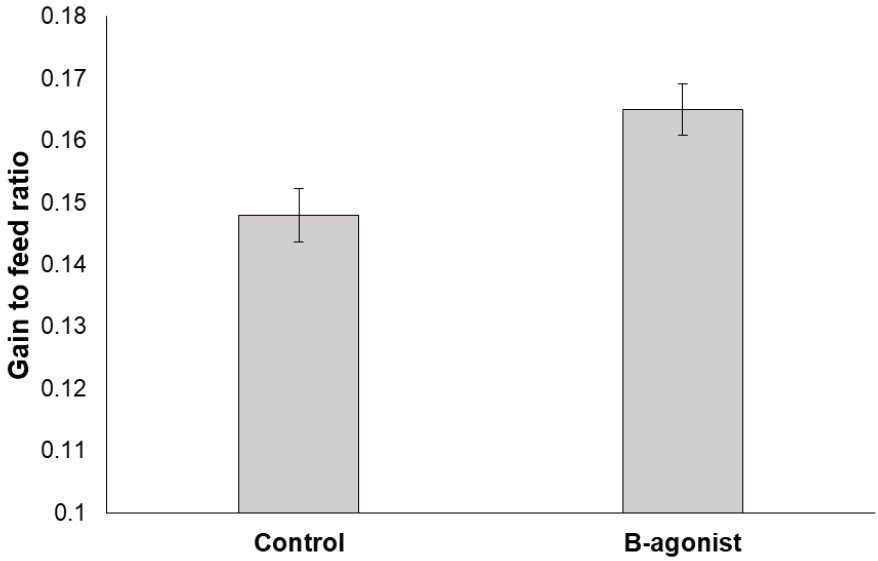

Figure 1. Influence of dietary beta-agonist addition on gain to feed ratio of beef cattle (P<0.001).

Effects of dietary beta-agonist addition on carcass characteristics of beef cattle are presented in Table 2. Beta-agonist elevated hot carcass weight (P<0.001) and dressing percentage (P<0.01), but had no effect on fat thickness. Longissimus muscle area increased (P<0.001; Figure 2) while marbling

score decreased (P<0.05) due to the addition of beta-agonist. The additive positively influenced Warner-Bratzler shear force of carcass (P<0.001) but had no effect on its pH value.

Table 2. Effects of dietary beta-agonist addition on carcass characteristics of beef cattle

Parameter	Unit	Control	Beta-agonist	Significance
HCW	kg	360±4.58	365±4.57	***
Dressing	%	62.7±0.269	63.0±0.267	**
Fat thickness	cm	1.25±0.038	1.25±0.038	ns
Marbling score	no unit	459±10.7	453±10.7	*
WBSF	kg	3.75±0.204	4.08±0.204	***
pH	no unit	5.52±0.063	5.52±0.063	ns

BW, body weight; DM, dry matter; ADG, average daily gain; ns, non-signifinance; ***, P<0.001.

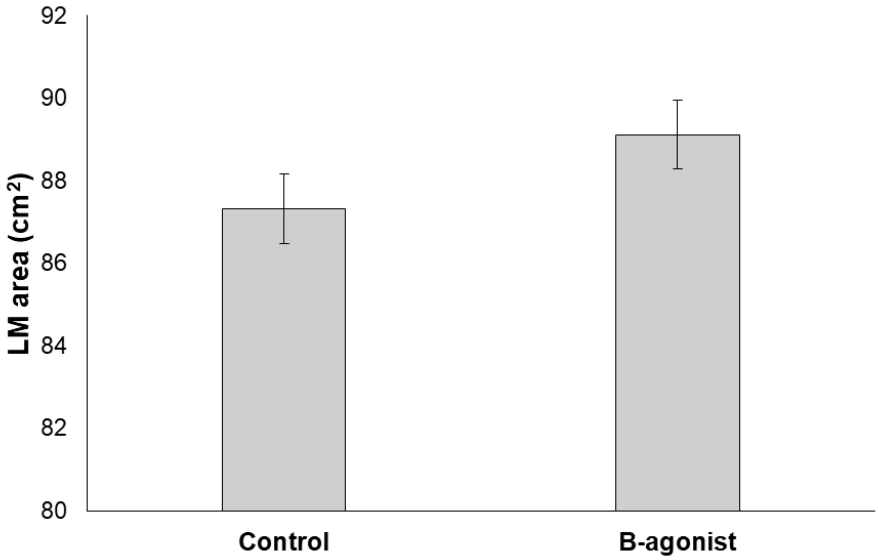

Figure 2. Influence of dietary beta-agonist addition on longissimus muscle (LM) area of beef cattle (P<0.001).

The increase of longissimus muscle area and the concomitant decrease of marbling score indicate that beta-agonist simultaneously enhances protein synthesis and reduces fat deposition in beef cattle, respectively [7-9]. Such responses further lead to the increase of body weight gain of the cattle without negatively affecting dry matter intake as also confirmed in the present meta-analysis study. Increase of average daily gain and gain to feed ratio due to beta-agonist addition is 10.8 and 11.5%, respectively. Subsequent beta-agonist evaluation by employing meta-analysis method is required in order to elucidate its optimum level for each beef cattle category (e.g., steers, bulls and heifers).

4. Conclusion

Beta-agonist favorably affects production performance and carcass property of beef cattle. It enhances body weight gain and feed utilization efficiency without negatively affecting feed intake. The substance also increases muscle proportion and simultaneously reduces fat proportion in the carcass of beef cattle.

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