RESEARCH ARTICLE

Effects of Dietary Supplementation with Turmeric and Ginger on Growth Performance and Antioxidant Enzyme Status in Pig

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Abstract

This research was aimed to evaluate the effect of dietary supplementation of turmeric and ginger @ 1% on the body weight on antioxidant profile in SVVU T-17 grower pigs. The study conducted over 60 days evaluated 72 SVVU T-17 crossbred grower pigs, which were divided into three groups. C (Control) group received only basal diet (as per NRC, 2012); T group supplemented with Turmeric @ 1% in basal diet and G group supplemented with Ginger @ 1% in basal diet. Results demonstrated that the treatment group T (42.33±0.91 kg) exhibited significantly higher mean body weights ($p<0.05$) compared to the control C (36.66±1.08 kg) and G group (36.00±2.55 kg). Antioxidant enzymes SOD (Superoxide Dismutase), Catalase and GSH-Px (Glutathione peroxidase) levels also increased significantly ($p<0.05$) in the treatment groups compared to the control. Additionally, lipid peroxidation levels (concentration of MDA) were decreased significantly ($p<0.05$) in Turmeric and Ginger supplemented groups compared to the control. These findings suggest a potential association between these antioxidant enzyme levels and the body weight gain of pigs, and that the dietary supplementation with Turmeric and Ginger significantly improves the antioxidant enzymes by decreasing lipid peroxidation levels and thereby improving the body weight gain in pigs.

Keywords: Antioxidant enzymes, Body weight, Ginger, Pig, Supplementation, Turmeric.

Ind J Vet Sci and Biotech (2025): 10.48165/ijvsbt.21.1.19

Introduction

Grower pigs have a rapid growth rate, which causes a great deal of stress and leads to poor performance and a high mortality rate. Reactive oxygen species (ROS) cause oxidative stress, which is a major contributor to a number of diseases. Dietary antioxidant supplementation is a promising strategy for lowering oxidative stress, since oxidative stress is brought on by an imbalance of prooxidants and antioxidants in the body. It is essential to use prebiotics, probiotics, essential oils (Issara *et al*., 2020), dietary enzymes, natural herbs, and medicinal plants (Lee *et al*., 2020) or phytobiotics (Fang *et al*., 2009) to modify the gut microbiota to have positive effects on the host.

The popular medicinal herb turmeric, is a rhizomes of the *Curcuma longa* plant. The root of the *Curcuma longa* is used as a spice, preservative, colouring agent, and for a variety of medicinal and pharmaceutical purposes. Oxygen radicals have been shown to catalyze the oxidative modification of lipids result in lipid peroxidation (Kurien and Scofield, 2006). Turmeric and its extract protect the lipids, haemoglobin and red blood cells from lipid peroxidation. It shields DNA from oxidative damage and hinders hazardous metabolite binding. The volatile and non-volatile phytochemicals in turmeric, which are less poisonous and have therapeutic effects like antioxidant, antibacterial, anti-inflammatory activities (Niranjan and Prakash, 2008). Since a very long time, ginger (*Zingiber officinale*), a member of the Zingiberaceae family and the Zingiber genus, has been widely used as a spice and an herbal remedy (Han *et al.,* 2013). Among the many antioxidants found in ginger, phenolic ketone derivatives are very effective. These chemicals present in ginger can scavenge superoxide anions, hydroxyl radicals and diminish the peroxidation of phospholipid liposomes. Several substances found in ginger, including gingerol, gingerdiol, and gingerdione, have potent antioxidant properties (Kikuzaki and Nakatani, 1996).

There is a dearth of study on effect of turmeric and ginger in pigs, particularly in the recently established SVVU T17 crossbred pig breed. Hence, the present study was aimed to evaluate the effect of dietary supplementation of turmeric and ginger on growth performance and antioxidative enzyme status of SVVU T17 grower pigs.

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How to cite this article: Bhargav, K., Varaprasad Reddy, L. S. S., Naik, B. R., Sivakumar, A. V. N., & Chakravarthi, M. K. (2025). Effects of Dietary Supplementation with Turmeric and Ginger on Growth Performance and Antioxidant Enzyme Status in Pigs. Ind J Vet Sci and Biotech. 21(1), 94-97.

Source of support: Nil

Conflict of interest: None

Submitted 20/11/2024 **Accepted** 19/12/2024 **Published** 10/01/2025

Materials and Methods

This study protocol was approved by Animal Ethics Committee of the College of Veterinary Science, Tirupati (Ref. no. 281/go/ReBi/S/2000/CPCSEA/CVSc/TPTY/022/ physiology/2022, dated 22.06.2022). The research work was carried out at Department of Veterinary Physiology and ICAR-AICRP on pigs, College of Veterinary Science, Tirupati (India) during June, July, August 2022 to evaluate the effects of supplementation of Turmeric and Ginger on growth performance and antioxidant status in SVVU T17 crossbred grower pigs. The experiment was conducted on 72 SVVU T17 crossbred grower pigs of around 3 months age for 60 days, that were assigned randomly into three homogeneous groups (C, T, G) each with 24 pigs. The pigs of treatment groups were dietary supplemented with Turmeric (T) @ 1%, *i.e.*, 10 g/kg and Ginger (G) @ 1%, *i.e.*, 10 g/kg in feed, while control (C) group received basal ration which was prepared according to NRC (2012). Composition of basal diet included maize 60%, SBM 24%, DORB 14%, Salt 0.5%, Mineral mixture 1.0% and Lysine hydrochloride 0.1%.

Feeding and Management

Grower pig housing facilities were meticulously cleaned and sanitized before the experiment was started. All of the pigs were kept in an animal shed with enough ventilation, food and water. Grower pigs were raised under the same management, environmental, and hygienic guidelines. Each and every pig was in good health and parasite-free both internally and externally. Additionally, sanitary precautions were also made to prevent sickness. Regular cleanings were performed on the animal home, water, and feeders. Grower pigs were given diets that followed the NRC (2012) recommendations, in addition to experimental feed and constant access to clean water. Every day at 10.30 AM and 2.30 PM, the three groups received their specific trial rations by weighing them in an automated balance. Experimental pigs were weighed before the start of the experiment and again on 30th day and 60th day of the experiment and weights were noted for evaluation of growth performance.

Assay of Lipid Peroxidation and Oxidative Stress Parameters

For the antioxidant enzyme estimation, blood samples were collected from all the animals in three groups on 60th day of the experiment. Haemolysate was made using blood that had been collected in EDTA vials. The buffy coat and plasma were extracted and eliminated by centrifugation. The resultant erythrocyte sediment was washed three times with a 0.9 % w/v NaCl solution, each time mixing and centrifuging the suspension before discarding the supernatant. In order to lyse the washed red blood cells, 4 parts of cold distilled water were added. This resulted in stock haemolysate solution (25 % v/v), which was then rapidly stored at -23°C. Using a UV-visible Spectrophotometer, the haemolysate was employed within two days to determine the level of oxidative stress and antioxidant status. Using Niehaus and Samuelsson's (1968) approach the concentration of MDA was estimated to determine the degree of lipid peroxidation. Estimation of enzyme activity in haemolysate, *viz,* catalase (Beers and Sizer, 1952), superoxide dismutase (Misra and Fridovich, 1972) and GSH-Px (Rotruck *et al.,* 1973) was performed using standard procedures.

The data obtained were subjected to analysis through software (version 22.0, SPSS 2013) by applying one-way analysis of variance through generalized linear model and the treatment means were ranked using Duncan's multiple range test with a significance at $p<0.05$. All the statistical procedures were done as per Snedecor and Cochran (1994).

Results and Discussion

Body Weights

The body weights of pigs in the all treatment groups recorded at the beginning (0th day), 30th day and end of the experiment (60th day) are presented in Table 1.

Antioxidative enzymes profile

The antioxidative enzymes profile that was designed for the studies calculated from haemolysate separated from blood collected at the 60th day of the experiment is represented in Table 2.

Table 1: Mean body weights (kg) of experimental pigs

Body weight	Control (C)	Turmeric (T)	Ginger (G)
Initial body weight (0th day) (kg)	20.00±0.57^{a}	20.33±0.66^{a}	19.83±0.70^{a}
30th day body weight (kg)	27.66±0.80^{a}	29.33±1.28^{a}	27.83±1.81^{a}
60th day body weight (kg)	36.66±1.08^{a}	42.33±0.91^{b}	36.00±2.55^{a}

Means with different superscript(s) within each row differ significantly ($p<0.05$).

Table 2: Antioxidative enzyme profile of experimental groups (60th day)

Parameter	Control (C)	Turmeric (T)	Ginger (G)
SOD (U/mg protein)	3.41±0.15^{a}	5.29±0.17^{b}	5.94±0.24^{c}
Catalase (U/mg protein)	1.33±0.13^{a}	2.25±0.17^{b}	2.02±0.08^{b}
MDA (µg/mL haemolysate)	6.38±0.08^{c}	4.47±0.21^{b}	3.83±0.17^{a}
GSH-Px (U/mg protein)	652.84±11.98^{a}	687.10±7.13^{b}	688.97±7.54^{b}

Means with different superscript(s) in each row differ significantly ($p<0.05$).

On 30th day of the experiment (Table 1), the study revealed that supplementation of turmeric and ginger did not change the body weights significantly ($p>0.05$), whereas on 60th day, a significant ($p<0.05$) increase in the body weight was observed in the turmeric supplemented (T) group. This indicates that the body weights in grower pigs were positively influenced by supplementation of turmeric aligning with the findings of Swathi *et al*. (2012), Alagbe (2017) and Recharla *et al*. (2021). The improvement in final body weights with turmeric supplementation may be due to compounds like curcuminoids, curcumin present in turmeric that enhance digestion and absorption of some nutrients in diets which cause greater efficiency in the utilization of feed, resulting in enhanced growth. In addition, according to the findings of Patel and Srinivasan (1996), pancreatic enzyme activity was dramatically increased when rats were fed curcumin. This suggests that curcumin may have digestive-enhancing qualities, which may promote growth performance. These findings highlight the potential benefits of dietary supplementation of turmeric in improving body weight gain in pigs.

In the current study, increased SOD activity in turmeric supplemented animals was in agreement with the findings of Alagawany *et al*. (2016), who reported an increase ($p<0.05$) in SOD activity in rabbits with dietary supplementation of turmeric powder. Similarly, Reddy & Lokesh (1994), and Moghadam *et al*. (2015) observed an increase in SOD levels with inclusion of dietary turmeric in rats, whereas Biswas *et al*. (2017) observed an ameliorative effect of turmeric powder in arsenic toxicity induced calves, they recorded an increase in SOD levels with turmeric supplementation. This clearly indicated that the dietary turmeric supplementation can increase antioxidant enzyme levels by combating the oxidative stress in healthy as well as toxicity induced animals. According to O'Loughlin *et al*. (2011), weaning is stressful for young animals, especially when it is combined with social, physical, dietary, and physiological stress. Oxidative stress can result in producing several ROS, including superoxide anion and hydroxyl free radicals in the body. However, the effect of phytogenic additives like turmeric was more pronounced in combating oxidative stress imposed during rapid growing stage in animals (Zeweil *et al*., 2016). In terms of scavenging free radicals, the superoxide dismutase is recognized as one of the most significant families of antioxidant enzymes.

Catalase activity in current study was increased ($p<0.05$) in turmeric group and the results were in accordance with the findings of Alagawany *et al*. (2016) in rabbits, Biswas *et al*. (2017) in calves, Reddy and Lokesh (1994), and Moghadam *et al*. (2015) in rats. In the cell, catalase reacts with H_2O_2 which is generated during oxidative stress to form water and molecular oxygen thereby protecting the cells against H_2O_2 toxicity and lipid peroxidation (Varaprasad Reddy *et al*., 2009). Catalase is an enzyme that converts hydrogen superoxide into water and oxygen. Supplementation of turmeric in the current study significantly elevated the catalase activity, efficiently protected the growing pigs from oxidative stress by scavenging the cytotoxic hydrogen peroxides and oxygen free radicals produced during rapid growth phase of grower pigs.

Similarly, the GSH-Px activity also increased ($p<0.05$) with dietary supplementation of turmeric powder as was reported by Alagawany *et al*. (2016) in rabbits, but was in contrast with Moghadam *et al*. (2015) in rats. However, selenium-dependent glutathione peroxidase (GSH-Px) enzyme reduces peroxides release and protects cells against the damaging effects of oxidation. GSH-Px has a general specificity in detoxification of both lipid hydroperoxides as well as organic hydroperoxides. It is also involved in the conversion of hydrogen peroxide to water (Varaprasad Reddy *et al*., 2009). Increase in GSH-Px activity with turmeric supplementation in current study indicated that the dietary supplementation of turmeric powder could combat the oxidative stress in growing pigs.

Whereas, the MDA concentration was decreased ($p<0.05$) significantly in turmeric powder supplemented group in the present study. This was in agreement with results of Alagawany *et al*. (2016), and Quiles *et al*. (2002) in rabbits, Reddy and Lokesh (1994), and Moghadam *et al*. (2015) in rats and was in contrast with findings of Sadeghi and Moghaddam (2018) in broilers. Numerous studies demonstrate that an excess of ROS can cause damage to proteins, nucleic acids, and other biological macromolecules as well as produce significant levels of MDA, which can cause tissue damage and eventually lead to disease. Free radicals attack carbon-carbon double bonds during a process called lipid peroxidation, which is reflected indirectly by the body's MDA levels. Lipid peroxidation is the result of diminished antioxidant defense when ROS levels rise (Yang *et al*., 2008).

However, group G, which received ginger supplementation, similarly displayed a large rise ($p<0.05$) in SOD, CAT, and GSH-Px levels as well as a significant ($p<0.05$) drop in MDA levels. Antioxidant enzymes including SOD, Catalase, and GSH-Px can eliminate extra ROS in the body (Ko *et al*., 2004).

Conclusion

The SVVU T17 pigs in turmeric supplemented group had a significantly higher body weight than other groups, whereas ginger group had no effect on body weight when compared to control group. Catalase, SOD and GSH-Px were significantly increased in turmeric and ginger groups, whereas MDA levels were significantly decreased in both turmeric and ginger supplemented groups when compared to control group. The body weight of SVVU T17 pigs supplemented with turmeric exhibited a positive effect compared to the control group indicating that the turmeric can act as growth promoting feed additive. Further the higher values of antioxidative enzymes in turmeric and ginger supplemented groups indicate a higher potential for turmeric and ginger as antioxidant.

Acknowledgement

The authors would like to thank the authorities of ICAR-AICRP on Pigs, Sri Venkateswara Veterinary University, Tirupati for facilitating the study.

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