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Effect of Feeding Neem, Ginger and Garlic on Immune Response and Gut Health in Giriraja Birds

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A B S T R A C T

An experiment was conducted to study the effect of feeding neem, ginger and garlic powder serum lipid profile and meat cholestrol in Giriraja birds. A total of 150 day old Giriraja birds were procured and allocated to five experimental groups each consisting of three replicates with ten chicks each. Experimental diets for broiler starter and finisher rations were formulated as per the ICAR (2013) standards using commonly available feed ingredients and basal diet (control) T_1 was prepared using corn and soya-bean meal (as per requirement) without supplementation of garlic, neem and ginger for day 1 to 56 days of experimental period and the experimental diets were prepared by incorporating treatment group T_2, T_3, T_4 and T_5 will be included with basal diet+ 0.5 % garlic powder, basal diet + 0.5 % neem powder, basal diet + 1 % ginger and basal diet + 0.5 % garlic powder + 0.5 % neem powder + 1 % ginger powder, respectively. The results revealed that feeding neem, ginger and garlic powder individually and also in combination resulted in no significant improvement on immune response against Newcastle disease. But significant difference was observed in Infectious bursal disease on the 56th day of the experiment and also showed non-significant ($P > 0.05$) difference on immune organs weight of birds fed with different treatment groups except bursa which was significant in group fed with 1 % ginger and combination. Significant ($P \leq 0.05$) reduction in *E. Coli* count compared to control group whereas *Lactobacillus* count was significantly increased in the groups fed with garlic, neem, ginger and combination. However feeding of 1 % ginger and combination have more beneficial effects in Giriraja birds.

Introduction

Poultry farming has emerged as one of the fastest growing agribusiness industries in the world. The term feed additive is applied in a broad sense, to all products other than those commonly called feedstuffs, which could be added to the ration with the purpose of obtaining some special effects. The main objective of adding feed additives is to boost animal performance by increasing their growth rate, better-feed conversion efficiency, greater livability and lowered mortality in poultry birds.

These feed additives are termed as "growth promoters" and often called as non-nutrient feed additives. Antibiotic growth promoters (AGP) have been used as a feed additive to enhance gut health and control sub-clinical diseases. Sub-therapeutic

levels of antibiotics given to poultry as growth enhancer may result to the development of antibiotic-resistant of bacteria, which are hazardous to animal and human health. The term "antibiotic growth promoter" is used to describe any medicine that destroys or inhibits bacteria which is administered at a low sub-therapeutic dose. The mechanism of action of antibiotics as growth promoters is related to interactions with intestinal microbial population.

There are some important bioactive components such as alkaloids, bitters, flavonoids, glycosides, mucilage, saponins, tannins (Vandergrift, 1998); phenols, phenolic acids, guinones, coumarins, terpenoids, essential oils, lectins and polypeptides (Cowan, 1999) in the structures of nearly all the plants. The large number of active compounds in these supplements may therefore present a more acceptable defense against bacterial attack than synthetic antimicrobials. There is evidence to suggest that herbs, spices and various plant extracts have antimicrobial effects which stimulate the growth of beneficial bacteria and minimize pathogenic bacterial activity in the gastrointestinal tract of poultry (Wenk, 2000). On the other hand, supplementing the diet with plant material that is rich in active substances with beneficial effects for the immune system can be used as an alternative to antibiotic growth promoters.

Neem (*Azadirachta indica*) is one of the most common wild growing trees in India. Neem and tulsi have attracted worldwide prominence due to its vast range of medicinal properties like antibacterial, antiviral, antifungal, antiprotozoal, hepatoprotective and various other properties without showing any adverse effects (Kale *et al.,* 2003). Neem and tulsi leaves extract has immunostimulant effect that activates the cell mediated immune response and therefore creates an enhanced response to any future challenges occurred by disease organisms. Low dose of neem leaves extract have an inhibitory action on wide spectrum of microorganisms (Talwar *et al.,* 1997) and immuonomodulatory actions that induce cellular immune reaction. Several herbs could help providing some protection against bacteria and stimulate the immune system.

Garlic (*Allum sativum*) is widely distributed all over the world. Garlic contains active principles like allum, allylic sulphide which lowers the low density lipo protein levels and act as anti carcinogenic. It possess antibacterial, antiparasitic, antiviral, antioxidant, anticholesteremic, anticancerous and vasodilator characteristics (Hanieh *et al.,* 2010).

Ginger (*Zincifer officinale*) is one of the potential rhizome with a wide range of medicinal effects (Khan *et al.,* 2012). The dietary supplementation of ginger had significant effects on the weight of visceral organs of broiler chickens (Tekeli, 2011). Improvement of sensory quality in broiler meat on feeding ginger (Kim *et al.,* 2015)

Sadekar *et al., (*1998) fed neem dry leaves to broilers and observed significant effect on the immune performance against IBD. The significant increase recorded in this study could be attributed to the effects of garlic and neem on B- lymphocyte which differentiate into memory cells and plasma cells.

Gardzielewska *et al.,* (2003) observed significant effect on the immune performance against IBD and ND. Garlic is very rich in aromatic oils, which enhance digestion and positively influenced respiratory system being inhaled into air sacs and lungs of birds. Also it was found that garlic has strong antioxidative effects. Iwalokun *et al., (2004)* observed garlic also has been shown to have strong antimicrobial and immune stimulating action.

The chemically active ingredient present in neem is nimbin which increases humoral and cell mediated immune responses. The significant increase in immune response in garlic and need attributed to the effects of garlic and neem on B- lymphocyte which differentiate into memory cells and plasma cells.

Anwarul *et al.,* (2018) observed no significant difference in spleen weight of broiler chicken in

control group and other treatment groups fed with different level of neem leaf powder.

Garlic contains active principles like allin, allylic sulphide, garlic has been used as a spice and native medicine for many years. It possess antibacterial, antiparasitic, antiviral, antioxidant, anticholesteremic, anticancerous and vasodilator characteristics.

Dieumou *et al.,* (2009) accessed the effect of ginger and garlic essential oils on growth performance and gut microbial population of broiler chicken by supplementing ginger and garlic oil at the rate of 10, 20 and 30 mg/kg/day. They observed significant decrease ($P < 0.05$) in the colony forming units of *Escherichia coli* and other enterobacteria in the digesta of ileo- caecum of broiler chicken on garlic essential oil compared to control.

Sujatha *et al.,* (2017) studied the efficacy of water supplements of Aloe vera and neem during pre-starter age on gut health. They observed significantly lowered ($P < 0.05$) *E. Coli* and increased *Lactobacillus* count in the groups respectively fed with Aloe vera and neem compared to the control group.

Materials and Methods

The experiment was conducted at the Department of Poultry Science, Veterinary College, Hebbal, Bengaluru. A total of 150 one day old Giriraja birds were distributed into five treatment groups with three replicates in each group and ten birds in each replicate. Chicks were reared under deep litter system with supply of *ad libitum* feed and water. The trial duration was for 8 weeks (56 days). A standard broiler starter and finisher rations were formulated as per ICAR (2013) recommendation. Basal diet (T_1) and the experimental diets were prepared by incorporating garlic powder at 0.50 per cent (T_2), neem powder at 0.50 per cent (T_3), ginger powder at 1.0 per cent (T_4) and garlic powder 0.5 per cent + neem powder 0.5 per cent + ginger powder 1 per cent (T_5). Blood samples were collected from two birds from each replicate on 56th day. Serum was separated and antibody titer against Newcastle disease virus and Infectious bursal disease virus was estimated by HA followed by HI test and ELISA test, respectively. Antibody titres against Newcastle disease and Infectious bursal disease was estimated using HA followed by HI (Allan and Gough, 1974) and using indirect ELISA kit, respectively at the end of trial in treatments groups. At the end of the experiment, two birds from each replicate in each treatment groups were slaughtered to record the weight of lymphoid organs viz., spleen, thymus and bursa of fabricius. The recorded weights were expressed as the per cent of pre slaughter bird weight (% of live weight). At the end of the experiment, two birds from each replicate in T_1 to T_5 treatment groups, respectively were slaughtered. Intestinal contents from the small intestine were taken aseptically. The intestinal contents were collected in sterile container and further subjected to enumeration of gut microbes as per spread plate method. Specific media such as MacConkey agar was used for *E. coli* count, whereas *Lactobacillus* was assessed on brain heart infusion agar by pour plate method.

Results and Discussion

Antibody titres against Newcastle disease and Infectious bursal Disease

The results of influence of feeding neem, ginger and garlic powder on antibody titers against Newcastle disease and Infectious bursal disease during 56^{th} day in Giriraja birds were presented in Table 1.

At the end of 56^{th} day, the antibody titres against Newcastle disease in groups T_1, T_2, T_3, T_4 and T_5 were 1.304, 1.391, 1.414, 1.396 and 1.417, respectively. ANOVA revealed no significant ($P > 0.05$) difference in antibody titre against Newcastle disease among the various treatment groups and also compared to control group.

At the end of 56^{th} day, the antibody titres against Infectious bursal disease in groups T_1, T_2, T_3, T_4 and

T_5 were 1559.43, 1562.71, 1584.66, 2498.88 and 2413.56, respectively. Statistical analysis revealed significant ($P \leq 0.05$) difference in antibody titres against Infectious bursal disease among the various treatment groups. The significantly higher antibody titer against Infectious bursal disease was observed in group T_4, T_5 compared to T_1, T_2 and T_3. There was no significant difference in antibody titre against Infectious bursal disease was observed in group T_4, T_5 and also among T_1, T_2 and T_3.

There was no significant difference ($P > 0.05$) in immune response against Newcastle disease in control and also compared all other treatment, whereas there was significant difference ($P \leq 0.05$) was observed against Infectious bursal disease in group fed with 1 % ginger and combination compared to control and group fed with 0.5 % garlic and 0.5 % neem.

In agreement with the present study Sadekar *et al., (*1998) fed Neem dry leaves to broilers and observed significant effect on the immune performance against IBD. The significant increase recorded in this study could be attributed to the effects of garlic/ neem on B- lymphocyte which differentiate into memory cells and plasma cells.

Neem has attracted worldwide prominence due to its vast range of medicinal properties like antibacterial, antiviral, antifungal, antiprotozoal, hepato protective and various other properties without showing any adverse effects. Feeding neem and tulsi leaves to immunosuppressed birds increased their humoral and cell mediated immune responses.

Garlic has been used as a spice and native medicine for many years. It possess antibacterial, antiparasitic, antiviral, antioxidant, anticholesteremic, anticancerous and vasodilator characteristics.

Immune organ weights (% of live weight)

The results of the influence of feeding neem, ginger and garlic powder on the per cent relative immune organ weights (% of live weight) at 56th day in Giriraja birds are presented in Table 2. The weight of spleen (% live weight) on 56th day of the experiment in groups T_1, T_2, T_3, T_4 and T_5 were 0.127, 0.129, 0.123, 0.131 and 0.123, respectively. Statistical analysis revealed no significant ($P > 0.05$) difference in weight of spleen between the treatments and control.

The weight of thymus (% live weight) on 56th day of the experiment in groups T_1, T_2, T_3, T_4 and T_5 were 0.333, 0.329, 0.337, 0.325 and 0.344, respectively.

ANOVA revealed no significant ($P > 0.05$) difference in weight of thymus between the treatments and control.

The weight of bursa (%) on 56th day of the experiment in groups T_1, T_2, T_3, T_4 and T_5 were 0.131, 0.147, 0.149, 0.171 and 0.199, respectively. Statistical analysis revealed significant ($P \leq 0.05$) difference in weight of bursa between the treatments and control.

There was a significant ($P \leq 0.05$) difference in the weight of bursa observed between group T_5 compared to T_1, T_2 and T_3 and also among T_4 and T_1. There was no significant ($P > 0.05$) difference was observed in the weight of bursa between T_1, T_2 and T_3 and also among T_2, T_3 and T_4 and also among T_4 and T_5.

There was no significant difference ($P > 0.05$) in immune response against Newcastle disease in control and also compared all other treatment, whereas there was significant difference ($P \leq 0.05$) was observed against Infectious bursal disease in group fed with 1 % ginger and combination compared to control and group fed with 0.5 % garlic and 0.5 % neem.

In agreement with the present study Sadekar *et al., (*2019) fed Neem dry leaves to broilers and observed significant effect on the immune performance against IBD. The significant increase recorded in this study could be attributed to the effects of garlic/ neem on B- lymphocyte which differentiate into

memory cells and plasma cells. Neem has attracted worldwide prominence due to its vast range of medicinal properties like antibacterial, antiviral, antifungal, antiprotozoal, hepato protective and various other properties without showing any adverse effects. Feeding neem and tulsi leaves to immunosuppressed birds increased their humoral and cell mediated immune responses.

Garlic has been used as a spice and native medicine for many years. It possess antibacterial, antiparasitic, antiviral, antioxidant, anticholesteremic, anticancerous and vasodilator characteristics.

Gut microbial count

The results of influence of feeding neem, ginger and garlic powder on gut (intestinal) microbial load (*log*$_{10}$ CFU/g) on 56th day in Giriraja birds are presented in Table 3.

Escherchia coli

At the end of 56th day, the intestinal *E.coli* count (*log*$_{10}$ CFU/g) in groups T_1, T_2, T_3, T_4 and T_5 were 7.69, 7.08, 7.01, 6.97 and 6.19, respectively. The significant ($P \leq 0.05$) difference was observed in the intestinal *E. coli* count among the treatments compared to control. The highest *E.coli* count was observed in groups T_1 when compared to other treatment groups.

The *E. coli* count (log_{10} CFU/ g) was significantly lower ($P \leq 0.05$) in the treatment group T_5 compared to T_1, T_2, T_3 and T_4 and also significantly lower ($P \leq 0.05$) count was observed in the treatment group T_2, T_3 and T_4 compared to control. There was no significant difference ($P > 0.05$) in the *E. coli* count among T_2, T_3 and T_4.

Lactobacillus spp.

At the end of 56th day, the intestinal *Lactobacillus* counts (*log*$_{10}$ CFU/g) in groups T_1, T_2, T_3, T_4, and T_5 were 6.26, 6.99, 7.02, 7.09 and 7.69, respectively. The significant ($P \leq 0.05$) difference was observed in the intestinal *Lactobacillus* counts among the treatments. The *Lactobacillus* count (log_{10} CFU/ g) was significantly ($P \leq 0.05$) higher in the groups T_5 compared to the control and other groups and also significantly higher ($P \leq 0.05$) count was observed in the treatment group T_2, T_3 and T_4 compared to control. There was no significant difference ($P > 0.05$) in the *Lactobacillus* count among the groups T_2, T_3 and T_4.

There was significant difference ($P \leq 0.05$) in gut microbial count of Giriraja birds in the groups fed with neem, ginger and garlic powder compared to the control group at the end of the experiment (56th day).

The present study is in agreement with Mul and perry (1994) it has been observed that prebiotic oligosaccharides and some plant extracts can influence the growth of commensal gut microflora by facilitating a continuous supply of specific substrates for the protective intestinal flora or by minimising risk of development of populations in which opportunistic pathogens can thrive.

The present study is in disagreement with Khatum *et al.*, (2013) supplemented tulsi and neem leaves to study the effect on broiler microbial load at the rate of 1, 2 and 3ml/litre of drinking water. They observed no significant difference ($P > 0.05$) in the microbial count in the groups fed with tulsi and neem compared to the control group.

This may be due to the methanol extract of *A. indica* leaves that shows antibacterial activity against *Bacillus subtilis, Staphylococcus aureus, Proteus vulgaris, Salmonella typhi* and showed low activity on *Pseudomonas aeruginosa* but it is ineffective against *Escherichia coli* (Grover *et al.*, 2011).

The immune response against Newcastle disease was non significant ($P > 0.05$) in group fed with garlic, neem and ginger powder at 0.5 per cent, 0.5 per cent, 1 per cent powder and combination of 0.5% garlic, 0.5 % neem, 1 % ginger powder respectively, compared to control on the 56th day.

Table.1 Effect of supplementation of Neem, Ginger and Garlic powder on antibody titres against Newcastle disease and Infectious bursal disease at the 56th day in Giriraja birds.

Experimental group	Description of the treatment	NDV (log_{10} HI titre)	IBDV titre (ELISA)
T_1	Basal diet	1.304 ± 0.30	1559.43 ± 288.30^{b}
T_2	Basal diet + 0.5% Garlic powder	1.391 ± 0.17	1562.71 ± 163.80^{b}
T_3	Basal diet + 0.5% Neem powder	1.414 ± 0.12	1584.66 ± 359.71^{b}
T_4	Basal diet + 1% Ginger powder	1.396 ± 0.22	2498.88 ± 231.06^{a}
T_5	Basal diet + 0.5% Garlic powder + 0.5% Neem powder + 1% Ginger powder	1.417 ± 0.18	2413.56 ± 291.49^{a}

^{abc} Means in the same column with no common superscript differ significantly ($P \leq 0.05$)

Table.2 Effect of supplementation of Neem, Ginger and Garlic powder on Lymphoid organs weight (g/100g body weight) (Mean ± SE) at the 56th day in Giriraja birds

Experimental group	Description of the treatment	Lymphoid organs weight (g/100g body weight)		
		Spleen	Bursa of Fabricius	Thymus
T_1	Basal diet	0.127 ± 0.153	0.131 ± 0.014^{c}	0.333 ± 0.043
T_2	Basal diet + 0.5% Garlic powder	0.129 ± 0.007	0.147 ± 0.004^{bc}	0.329 ± 0.011
T_3	Basal diet + 0.5% Neem powder	0.123 ± 0.017	0.149 ± 0.009^{bc}	0.337 ± 0.024
T_4	Basal diet + 1% Ginger powder	0.131 ± 0.111	0.171 ± 0.008^{ab}	0.325 ± 0.037
T_5	Basal diet + 0.5% Garlic powder + 0.5% Neem powder + 1% Ginger powder	0.123 ± 0.007	0.199 ± 0.006^{a}	0.344 ± 0.030

^{abc} Means in the same column with no common superscript differ significantly ($P \leq 0.05$)

Table.3 Effect of supplementation of Neem, Ginger and Garlic powder on Gut microbial counts (log_{10} CFU/g) (Mean ± SE) at the 56th day in Giriraja Birds.

Experimental group	Description of the treatment	E. coli count	Lactobacillus count
T_1	Basal diet	7.69 ± 0.032^{a}	6.26 ± 0.043^{c}
T_2	Basal diet + 0.5% Garlic powder	7.08 ± 0.014^{b}	6.99 ± 0.019^{b}
T_3	Basal diet + 0.5% Neem powder	7.01 ± 0.023^{b}	7.02 ± 0.013^{b}
T_4	Basal diet + 1% Ginger powder	6.97 ± 0.051^{b}	7.09 ± 0.023^{b}
T_5	Basal diet + 0.5% Garlic powder + 0.5% Neem powder + 1% Ginger powder	6.19 ± 0.049^{c}	7.69 ± 0.019^{a}

^{abc} Means in the same column with no common superscript differ significantly ($P \leq 0.05$)

The immune response against Infectious bursal disease was significant ($P \leq 0.05$) in group fed with 1 % ginger powder and combination of 0.5 % garlic, 0.5 % neem, 1 % ginger powder respectively, compared to control and 0.5 % garlic, 0.5 % neem on the 56th day.

The immune organs weight was significant ($P \leq 0.05$) in bursa in group fed with 1 % ginger and combination of 0.5 % garlic, 0.5 % neem and 1 % ginger powder compared to control and 0.5 % garlic and 0.5 % neem at the end of the experiment (56th day).

The Gut microbial count on *E. coli and Lactobacillus spp.* in different groups of birds fed with garlic, neem and ginger powder at 0.5 per cent, 0.5 per cent, 1 per cent powder and combination of 0.5 % garlic, 0.5 % neem, 1 % ginger powder, respectively had significant difference ($P \leq 0.05$) when compared to control group at the end of the experiment (56th day).

Inclusion of garlic, neem and ginger powder at 0.5 per cent, 0.5 per cent, 1 per cent powder and combination of 0.5 % garlic, 0.5 % neem, 1 % ginger powder, respectively had no significant improvement on immune response against Newcastle disease. But significant difference was observed in Infectious bursal disease on the 56th day of the experiment in the inclusion of 1 % ginger and combination of 0.5 % garlic, 0.5 % neem and 1 % ginger powder and also showed non-significant ($P > 0.05$) difference on immune organs weight of birds fed with different treatment groups compared to control except bursa which was significant in group fed with 1 % ginger and combination compared to control and 0.5 % garlic and 0.5 % neem at the end of the experiment (56th day).

Inclusion of garlic, neem and ginger powder at 0.5 per cent, 0.5 per cent, 1 per cent powder and combination of 0.5 % garlic, 0.5 % neem, 1 % ginger powder, respectively revealed significant ($P \leq 0.05$) reduction in *E. Coli* count compared to control group whereas *Lactobacillus* count was significantly increased in the groups fed with garlic, neem, ginger and combination of garlic, neem and ginger compared to control group at the end of 56th day.

References

Anwarul Haque Beg. Md., Zahir Uddin Rubel. Md., Aftabuzzaman. Md., Toufik Ahmed Nahid. Md. and Maksuda Begum. Md., 2018. Efficacy of neem leaf meal as an alternative in broiler ration. *Asian. J. of res. in anim and vet. Sci*., 2(4): 1-10

Cowan, M. M. 1999 plant products as antimicrobial agents. Clinical Microbiology Review. 12(4): 564-582

Dieumou, F., Kulate, J. R., Teguia. A. and Tamokou, J. D. 2009. Effects of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) essential oils on growth performance and gut population of broiler chickens. *Livestock Res. Rural Dev*., 21(8)

Gardzielewska., L. M. T. Fadlalla., B. H. Mohammed., A. O. Bakhiet., 2010. Effect of feeding garlic on the performance and immunity of broilers. *Asian. J. of Poult. Sci.*, 4(4): 182-189

Grover, A., Bhandari, B. S. and Rai, N., 2011. Phytochemical evaluation and hepato protective activity of fresh juice of young stem bark of neem. *Int. J. Pharm. Pharmacol. Sci.*, 3(2): 1059-1065

Hanieh, H., Narabara, K., Piao, M., Gerile, C., Abe, A. and Kondo, Y., 2010. Modulatory effects of two levels of dietary Alliums on immune responses. *Anim. Sci. J.*, 81:673-680

Iwalokun., L. M. T. Fadlalla., B. H. Mohammed., A. O. Bakhiet. 2010. Effect of feeding garlic on the performance and immunity of broilers. *Asian. J. of Poult. Sci*., 4(4): 182-189

Kale, B. P., Kothekar, M. A., Tayade, H. P., Jaju, J. B and Mateeddin, M. 2003. *Indian. J. of Pharmacol.*, 35:177

Khan. M, Ullah. N, Azhar. M,, Komal and Wali. M., 2012 A mini review on the therapeutic potential of *Zingifer offinale* (ginger). *Nat. Prod. Ind. J.*, 15(1): 125

Khatum, S., Mostofa, M., Alom, F., Uddin, J., Alam, M. N., and Moitry, N. F., 2013. Efficacy of tulsi and neem leaves extract in broiler production. *Bangl. J. Vet. Med.*, 11(1): 1-5

Kim., Ismoyowati., Diana Indrasanti., Mochamad Mufti., Abdoreza Soleimani Farjam., 2015. Phytobiotic properties of garlic, red ginger, turmeric and kenchur in growing ducks. *Anim. Prod.*, 17(1): 49-55

Mul and Perry., Lan., 2005. Phytobiotics: alternatives to antibiotic growth promoters in monogastric animal feeds. *Recent Adv. in Anim. Nutri. in Aust*., 15(2): 131-140

Sadekar, 2019 Administration of garlic and neem in broiler diet for safe meat production. *Bang. J. Anim. Sci*.. 48(2): 116 - 126

Sujatha, T., Abhinaya, S., Sunder, J., Thangapandian. M., and Kundu, A., 2017. Efficacy of early chick nutrition with *Aloe vera* and *Azadirachta indica* on gut health and histomorphometry in chicks. *Vet. World.*, 10(6): 569-573

Talwar, G. P., Raguvanshi, P., Misra, R., Mukherjee. S., Shah, S. 1997. Plant immunomodulators for termination of unwanted pregnancy and contraception and reproductive health. Immunology & Cell Biology, 75(2):190-192

Tekeli, A., Kutlu, H. R. and Celik, L., 2011. Effects of feeding ginger on some blood parameters of broiler chicks. *Curr. Res. Poult. Sci. J*., 1: 12 – 23

Vandergrift, B. 1998. Biotechnology in the Feed Industry. In: Proc. Altech's 14th Annual Symposium Altech Technical Publications Nottingham University Press. Nicholasville. K.Y. 293-30

Wenk, C. 2000. Why all the discussion about herbs?. In: Proc. Alltech's 16th Ann. Symp. Biotechnology in the Feed Industry. (Ed. Lyons, T. P.), Alltech Tech. Publ., Nottingham, University Press, Nicholasville, KY. 79-96

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