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RESEARCH ARTICLE

Productive performance and physiological responses of growing rabbits fed diets supplemented with different levels of neam leaves and oil - a review.

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Abstract

Recently, rabbit production in Egypt has proliferated, mainly to accommodate the increasing demand for fresh meat for human consumption and as a source of additional revenue for Egyptian households or small farms. Modern trends in feeding rabbits on herbs because of their great importance in the physiological responces of the body to produce and strengthen production, the neem tree (*Azadirachta indica*) plant is atypical example of herbs, as it has many benefits because all parts of the neem tree- leaves, flowers, seeds, fruits, roots and bark have been used traditionally for the treatment of inflammation, infections, fever, skin diseases and dental disorders. The medicinal utilities have been described especially for neem leaves. Neem leaf and its constituents have been demonstrated to exhibit immunomodulatory, anti-inflammatory, antihyperglycaemic, antiulcer, antimalarial, antifungal, antibacterial, antiviral, antioxidant, antimutagenic and anticarcinogenic properties. This review summarises the wide range of pharmacological activities of neem leaf. Therefor, recent reaserch has proven great important for the application of neem and its products from leaves, flowers, fruits, oil and bark in animal nutrition.

Keywords: Herbs; Production; Neem; Rabbits.

1. Introduction

Recently, rabbit production in Egypt has proliferated, mainly to accommodate the increasing demand for fresh meat for human consumption and as a source of additional revenue for Egyptian households or small farms(Abdel-Wareth *et al.*, 2015). Moreover, that rabbit meat is rich in protein (22g/100g) and low in cholesterol (50g/100g), fat (4g/100g), and energy (124 Kcal/100g) Pla *et al.* (2004) . The meat has a complete amino acid profile, a pleasant flavour, and is readily digestible (Cheeke, 1986; Owen, 1981). In rabbit production, feeding is the main cost, so feed intake control could adjust the diet and nutritional requirements to manage the growth performance (Yakubu *et al.*, 2007).

Accordingly, diet can be enhanced by supplementation of a broad range of elements, including herbal medicines or extracts (Wenk *et al.*, 2000; Grela *et al.*, 2007). Consequently, Research in recent years has been focused on herbal supplementation to animal diets with fewer side effects and is environmentally friendly to manage infectious illnesses. One of these substances is neem which is a widely recognized plant.

Several articles demonstrated the efficiency of using herbal medicines in livestock diets due to its outstanding nutritional and therapeutic values, including antibacterial, anti-viral, anti-inflammatory, and anti-oxidant properties (Klusek *et al.*, 1997; Grela and Semeniuk,

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2006). It has been reported that these substances can stimulate appetite, regulate digestion and metabolism, have anti-diarrheal properties, and stimulate hormonal and immune systems (Grela and Semeniuk, 2006). Herbal extracts are potentially beneficial as growth promotors in diets and play a good role as therapeutic agents to treat certain diseases and disorders. They can replace antibiotics, enhancing immunity, and fight pathogenic bacteria and viral infections (Alimon, 2009). Neem has many incredible medicinal benefits Because it contains many the active componenets like limonoids, azadirachtin, meliantriol, salannin, Nimbin, Nimbidin and deacetylazadirachtinol.

but one of the most important things is that it kills cancerous cells and helps destroy harmful bacteria. Researchers have found that neem products are virtually nontoxic and are compatible with beneficial insects, pollinators and bees. They are environmentally benign, sustainable, renewable and affordable, it also significantly enhances metabolism. Traditionally, neem leaves are used to treat head lice, skin diseases, wounds or skin ulcers. External application of neem also finds merit as a mosquito repellant. Neem is probably the world's oldest skin softener and has been used for this purpose for millennia. Neem leaves can be boiled in water and the water can be strained and stored for use as a skin ointment.

2. Effects of Neem on feed intake and growth performance of rabbits

2.1. Productive performance:

2.1.1. Live body weight and weight gain

Body weight is concerning as the most important item in meat type rabbits production. Almost the aim of each research is to maximize body weight, feed conversion and minimize the production cost per unit. The current study aimed to evaluate adding neem leaves or oil levels on rabbits' productive performance as well as physiological responses.

Oluwafemi and Oluwayinka (2020**)** repoted that, supplementation different levels of neem oil at (0.1 ,0.2 , 0.3 and 0.4%) to rabbits diets significantly (P<0.05) increased final body weight compared to control group.

Kharde and Soujanya (2014**)** found that supplementation neem leaves powder on broiler chicks diets at 2g/kg significantly (P<0.05) improved the body weight.

Landy *et al.* (2011**)** revealed that supplementation neem fruits powder on broiler chikens diets at 7 gm and 12 gm /kg diets significantly (P<0.05) increased live body weight compared to control group especially by 7gm/kg diets from neem fruits powder.

Kumari *et al.* (2014) reported that supplementation neem leaves to chicken diets at 2.5% significantly (P<0.05) increased body weight and weight gain compared to control group.

Odunsi *et al.* (2009**)** found that, supplementation neem seeds on the cockerel chicken's diets significantly (P<0.05) increased final body weight compared to control group.

Supplementation of different level of neem leaf at (5, 10 and 15%) significantly (P<0.05) decreased final body weight and weight gain on rabbits compared to control group. (Obgbuewu *et al.,* 2010; Unigwe *et al.,* 2016; Ubua *et al.,* 2019**)**.

Kyere *et al.* (2018) found that, supplementation of neem leaves to pearl guinea fowls diets at (3 ,6 and 9%) significantly (P<0.05) decreased final body weight at 3% and 9%. On the other hand, neem leaves at 6% significantly (P<0.05) increased final body weight compared to control group.

Khalil (2003) found that, supplementation of neem leaves extract to rabbits significantly (P<0.05) decreased body weight compared to control group.

Nnenna and okey (2013**)** reported that, supplementation of aqueous neem leaf extract to broiler chicks water at 20, 40 and 60 ml per 1 litre of water significantly (P<0.05) decreased

final body weight at the level of 20 ml/litre, however aqueous neem leaf extract at 40ml and 60ml /litre significantly (P<0.05) increased final body weight compared to control group.

Zuraini *et al.* (2006) found that rats fed treated with Neem leaf extract at doses of 50 and 300 mg/kg/day orally did not show any significant effect.

Ekine and Samuel (2020**)** reported that supplementation of neem leaves to broiler diets at (1, 2, 3 and 4%) did not show any significant different in body weight gain.

2.1.2. Feed intake and Feed conversion ratio

Many studies indicated that feed intake was decreased in rabbit fed different levels of neem leaves or oil, for example, Ozung *et al.* (2019) who found that feed intake was significantly (P<0.05) decreased and improved feed convertion ratio in rabbit fed diet supplemented with 5, 10 and 15% neem leaves compared to control group. Likewise, Unigwe *et al.* (2016) addition of 5, 10 and 15 % neem leaf to rabbit diets resulted in a significantly decreased in a total feed intake and there were inhance in feed convertion ratio compared to control group.

Landy *et al.* (2011) found that supplementation of neem fruits powder to broiler chikens diets 7 and 12 gm neem fruits powder /kg diets and revealed that neem fruits powder at 7gm/kg significantly (P<0.05) increased fed intake and feed convertion ratio of chickens and there were decreased in feed convertion ratio compared to control group.

Kyere *et al.* (2018) found that supplementation of neem leaves to pearl guinea fowls diets at (3, 6 and 9%) neem leaves significantly (P<0.05) decreased total feed intake and feed convertion ratio compared to control group.

Odunsi *et al.* (2009) found that supplementation neem seeds on the cockerel chickens diets at 10% and 20% neem seed cake (CNSC) significantly (P<0.05) increased total feed intake compared to control group.

Kumari *et al.* (2014) observed that supplementation of neem leaves to chicken at 2.5% neem leaves significantly (P<0.05) improved feed intake and there were no significant differences in feed convertion ratio compared to control group.

Kharde and Soujanya (2014) reported that supplementation of neem leaves powder on broiler chiches diets at 0.5, 1 and 2 gm/kg significantly (P<0.05) decreased feed conversion ratio compared to control group.

3. Effects of Neem on Blood biochemestery of rabbits

3.1. Haemoglobin

Ogbuewu *et al.* (2010) found that supplementation of neem leaves to rabbits diets at (5, 10 and 15%) did not show any significant difference on haemoglobin concentration on rabbits blood.

Kyere *et al*. (2018) reported that supplementation of neem leaves to pearl guinea fowls diets at (3, 6 and 9%) significantly (P<0.05) decreased haemoglobin concentration of pearl guinea fowls blood compared to control group.

Nnenna and okey (2013) found that supplementation of aqueous neem leaf extract to broiler chicks water at 20, 40, 60 ml per 1 litre of water significantly (P<0.05) increased haemoglobin concentration of broiler chicks blood compared to control group.

Odunsi *et al.* (2009) found that supplementation of neem seeds on the cockerel chickens diets significantly (P<0.05) increased haemoglobin concentration on cockerel chickens blood compared to control group.

Oluwafemi and Oluwayinka (2020) reported that supplementation of different levels of neem oil at (0.1, 0.2, 0.3 and 0.4%) to rabbits diets significantly (P<0.05) increased haemoglobin concentration on rabbits blood compared to control group.

Ozung *et al.* (2019) found that supplementation of neem leaves at (5, 10 and 15%) to rabbits diets significantly (P<0.05) decreased haemoglobin concentration on rabbits blood, however neem leaves at 10% did not show any significant different in haemoglobin concentration on rabbits blood compared to control group.

Unigwe *et al.* (2016) reported that supplementation of different levels of neem leaf (5, 10 and 15%) significantly (P<0.05) increased haemoglobin concentration on rabbits blood compared to control group.

Khalil (2003) found that supplementation of neem leaves extract to rabbits significantly (P<0.05) decreased haemoglobin concentration on rabbits blood as compared to control group.

Kumari *et al.* (2014) found that supplementation of neem leaves to chicken diets 2.5% significantly (P<0.05) decreased haemoglobin concentration, however in other addation groups significantly (P<0.05) increased haemoglobin concentration on chicken blood compared to control group.

3.2. Total protein concentration, Albumin and Globulin

Ogbuewu *et al.* (2010) found that supplementation of neem leaves NLM at (5, 10 and 15%) to rabbits diets y significantly (P<0.05)decreased total protein and albumin concentration, However at 10% and 15% NLM significantly increased albumin concentration compared to control group.

Ogbuewu *et al.* (2015) reported that supplementation neem leaves at (5, 10 and 15%) to rabbits diets significantly (P<0.05) decreased total protein concentration and globulin, however albumin levels increased on rabbits blood compared to control group.,

Bratte *et al.* (2015) reported that supplementation neem leaves at (2.5, 5, 7.5 and 10%) to chicken diets significantly (P<0.05) increased total protein concentration on chicken blood compared to control group, except at 2,5 and 7,5% total protein concentration decreased significantly (P<0.05) on chicken blood compared to control group.

Oluwafemi and Oluwayinka (2020) reported that supplementation of different levels of neem oil (0.1, 0.2, 0.3 and 0.4%) to rabbits diets did not show any significant changes on total protein but significantly (P<0.05) increased globulin concentration on rabbits blood compared to control group.

Ogbuewu *et al.* (2010) found that supplementation of neem leaves to rabbits diets at (5 , 10 and 15%) did not show any significant changes on total protein concentration but increased albumin. However, globulin levels decreased on rabbits blood compared to control group.

Kyere *et al.* (2018) reported that supplementation of neem leaves to pearl guinea fowls diets at (3, 6 and 9%) significantly (P<0.05) increased total protein , albumin and globulin concentration on blood as compared by control group.

Nnenna and okey (2013) reported that supplementation aqueous neem leaf extract to broiler chicks water at 20, 40 and 60 ml per 1 litre of water significantly (P<0.05) increased total protein , albumin and globulin concentration on broiler chicks blood compared to control group.

Kumari *et al*. (2014) found that supplementation neem leaves to chicken at 2.5% significantly (P<0.05) increased total protein concentration on chicken blood , however other neem treatments did not show any significant in total protein concentration compared to control group.

Bratte *et al.* (2015) supplemented neem leaves at (2.5, 5, 7.5 and 10%) to chicken diets and revealed that neem leaves at 2.5% significantly (P<0.05) increased albumin concentration on chicken blood, however at 7.5% and 10% neem leaves significantly (P<0.05) decreased albumin concentration on chicken blood and there was no significant difference at 5%neem leaves compared with control group.

El-Zaiat *et al.* (2021) supplemented neem seeds oil on sheep diets at 20 and 40 ml/ sheep per day and revealed that neem seeds oil significantly (P<0.05) increased globulin concentration on sheep blood compared to control group.

3.3. Urea and creatinine concentration

Ogbuewu *et al.* (2015) found that supplementation neem leaves to rabbits diets at (5, 10 and 15%) significantly (P<0.05) decreased urea concentration on rabbits blood, however no significant differences on creatinine concentration were found.

Ozung *et al.* (2019) found that supplementation of neem leaves at (5, 10 and 15%) to rabbits diets did not show any significant different in urea and creatinine concentration among groups.

Nnenna and okey (2013) reported that supplementation aqueous neem leaf extract to broiler chicks water at 20, 40 and 60 ml per 1 litre of water significantly (P<0.05) increased urea concentration, although there were significantly (P<0.05) decreased on the levels of creatinine concentration compared to control group.

3.4. cholesterol concentration

supplementation of neem leaves at (5, 10 and 15%) to rabbits diets significantly decreased cholesterol consentration on rabbits compared to control group (Ogbuewu *et al.,* (2010) and Ogbuewu *et al.,* (2015))

Bratte et al. (2015) supplemented neem leaves at (2.5, 5, 7.5 and 10%) to chicken diets and revealed that neem leaves at 5% ,7.5% and 10% significantly (P<0.05) increased cholesterol consentration, however at 2.5% cholesterol consentration significantly decreased on chicken blood compared to control group.

Oluwafemi and Oluwayinka (2020) indicated that supplementation of different levels of neem oil at (0.1 , 0.2, 0.3 and 0.4%) to rabbits diets significantly(P<0.05) decreased cholesterol consentration compared to control group.

El-Zaiat *et al.* (2021) found that supplementation neem seeds oil on sheep diets at 20 and 40 ml/ sheep per day significantly (P<0.05) decreased cholesterol consentration compared to control group.

Ogbuewu *et al.* (2015) found that supplementation neem leaves to rabbits diets at (5, 10 and 15%) significantly(P<0.05) decreased cholesterol concentration compared to control group.

Nnenna and okey (2013) reported that supplementation aqueous neem leaf extract to broiler chicks water at 20, 40 and 60 ml per 1 litre significantly(P<0.05) decreased cholesterol concentration compared to control group.

Ekine and Samuel (2020) found that supplementation neem leaves on broiler diets at (1, 2, 3 and 4%) significantly (P<0.05) increased total cholesterol concentration compared to control group.

Khalil (2003) found that supplementation neem leaves extract to rabbits significantly (P<0.05) decreased total cholesterol concentration compared to control group.

Kumari *et al.* (2014) found that supplementation neem leaves to chicken diets at 2.5% significantly (P<0.05) decreased cholesterol concentration compared to control group.

3.5. glucose concentration

Ogbuewu *et al.* (2010) supplemented neem leaves at (5, 10, 15%) in rabbits diets and noted that neem leaves at 10 and 15% decreased significantly (P<0.05) glucose consentration, however at 5% (NLM) increased significantly (P<0.05) glucose concentration on rabbits compared with control group.

Ogbuewu *et al.* (2010) reported that supplementation of neem leaves at (5 ,10 and 15%) to rabbits diets and observed that neem leaves at 5% and 10% there were no significant differents on glucose consentration on rabbits blood ,however there is significantly (P<0.05) decreased glucose consentration on rabbits blood

at 15% neem leaves compared with control group.

Oluwafemi and Oluwayinka (2020) reported that supplementation of different levels of neem oil at (0.1 , 0.2, 0.3 and 0.4%) to rabbits diets significantly (P< 0.05) decreased glucose consentration on rabbits blood compared to control group.

Ogbuewu *et al.* (2015) found that supplementation of neem leaves to rabbits diets at (5, 10 and 15%) neem leaves and observed that neem leaves at 15% significantly (P<0.05) decreased glucose concentration, however neem leaves at 5% and10% there were no significant differents on glucose concentration compared to control group.

Nnenna and okey (2013) reported that supplementation aqueous neem leaf extract to broiler chicks water at (20, 40, 60) ml aqueous neem leaf extract per 1 litre significantly (P<0.05)decreased glucose concentration on broiler chicks blood compared to control group.

Zuraini *et al.* (2006) found that supplementation of neem leaves ethanolic extract on rats did not show any significant changes in glucose concentration while at diabetic group addition of streptozotocin significantly (P<0.05) increased glucose concentration on rats, however at diabetic added neem leaves extract group significantly (P<0.05) decreased glucose concentration on rats compared to control group.

Khalil (2003) found that supplementation of neem leaves extract to rabbits significantly (P<0.05) decreased glucose concentration compared to control group.

Kumari *et al.* (2014) found that supplementation of neem leaves to chicken at 2.5% neem leaves significantly (P<0.05) decreased glucose concentration compared to control group.

3.6. Serum aspartate amino transferase (AST) and alanine amino transferase (ALT)

Ogbuewu *et al.* (2010) reported that supplementation neem leaves at (5, 10 and 15%) to rabbits significantly (P<0.05)decreased serum aspartate amino transferase and alanine amino transferare ,however at 5%(NLM) significantly (P<0.05) increased serum aspartate amino transferare and alanine amino transferare compared to control group.

Ogbuewu *et al.* (2015) found that supplementation of neem leaves at (5, 10 and 15%) to rabbits diets the result did not show any significant changes on serum aspartate amino transferase and alanine amino transferare concentration compared to control group.

Seriana *et al.* (2021) revealed that supplementation of neem leaf ethanolic extracts at (100, 200 and 300) ml/kg from rat body weight and indicated that neem leaf ethanolic extracts at 100 ml/kg body weight significantiy (P<0.05) decreased serum aspartate amino transferase and increased alanine amino transferare concentration, however neem leaf ethanolic extracts at 200 and 300 ml/kg body weight significantiy(P<0.05) increased serum aspartate amino transferase concentration compared to control group.

Ekine and Samuel (2020) found that supplementation of neem leaves on broiler diets at (1, 2, 3 and 4%) and revealed that neem leaves significantiy (P<0.05) decreased serum aspartate amino transferase concentration, however levels of alanine amino transferare concentration did not show any significant changes compared to control group.

3.7. High-density lipoprotein (HDL) and low-density lipoprotein (LDL)

Zuraini *et al.* (2006) found that subblementation of neem leaves ethanolic extract on rats significantly (P<0.05) decreased high-density lipoprotein and the low-density lipoprotein levels increased compared to control group.

Ekine and Samuel (2020) found that supplementation of neem leaves on broiler diets at (1, 2, 3 and 4%) significantly (P<0.05) decreased high-density lipoprotein and the low-density lipoprotein levels increased compared to control group.

Khalil (2003) reported that supplementation of neem leaves extract to rabbits significantly (P<0.05) decreased high-density lipoprotein and the low-density lipoprotein levels increased compared to control group.

Kumari *et al.* (2014) found that supplementation neem leaves to chicken diets at 2.5% neem leaves significantly (P<0.05) decreased high-density lipoprotein concentration,however other treatments significantly (P<0.05) increased high-density lipoprotein ,although there were improved in low-density lipoprotein levels compared to control group.

3.8. Red Blood Cells and White Blood Cells

Oluwafemi and Oluwayinka (2020) indicated that supplementation of different levels of neem oil at (0.1 , 0.2, 0.3 and 0.4%) to rabbits diets there were no significant different on red blood cells and increased white blood cells compared to control group.

Ogbuewu *et al.* (2015) found that supplementation of neem leaves to rabbits diets at (5 , 10 and 15%) neem the results show no significant differents on red blood cells and white blood cells concentration compared to control group.

Kyere *et al.* (2018) found that supplementation of neem leaves to pearl guinea fowls diets at (3, 6 and 9%) neem leaves significantly (P<0.05) increased red blood cells and white blood cells concentration compared to control group.

3.9. Mean cell volume, Mean cell hemoglobin, Mean cell hemoglobin concentration and packed cell volume

Ogbuewu *et al.* (2010) found that supplementation neem leaves to rabbits diets at (5, 10 and 15%) neem leaves and observed that neem leaves at 5% and 15% significantly (P<0.05) decreased mean cell volume,however neem leaves at 10% there were no significant different and levels of Mean cell hemoglobin did not show any significant changes compared to control group.

Unigwe *et al.* (2016) found that supplementation of neem leaves at (5, 10 and 15%) on rabbits diets and reveald that there were any significant different of mean cell volume, Mean cell hemoglobin and Mean cell hemoglobin concentration, however there were increased packed ceel volume of rabbits compared to control group.

Ozung *et al.* (2019) found that supplementation of neem leaves at (5, 10and 15%) to rabbits diets and revealed that neem leaves at 5% and 10%

Nnenna and okey (2013) reported that supplementation of aqueous neem leaf extract to broiler chicks water at (20, 40, 60) ml aqueous neem leaf extract per 1 litre significantly (P<0.05) increased red blood cells and decreased white blood cells concentration blood compared to control group.

Odunsi *et al.* (2009) found that unprocessed neem seed cake significantly (P<0.05) increased red blood cells and white blood cells concentration on cockerel chickens blood.

Ozung *et al.* (2019) found that supplementation of neem leaves at (5, 10 and 15%) to rabbits diets and revealed that neem leaves at 5% and 10% significantly (P<0.05) increased red blood cells concentration, however neem leaves at 15% significantly (P<0.05) decreased red blood cells, while neem leaves at 10% and 15% significantly (P<0.05) increased white blood cells concentration, however neem leaves at 5% significantly (P<0.05) decreased white blood cells concentration compared to control group.

Unigwe *et al.* (2016) reported that supplementation of different level of neem leaf (5, 10 and 15%) and observed that no significant different on red blood cells concentration, while at 10% didn't show any significant different in white blood cells concentration, however neem leaves at 5% and 15% significantly (P<0.05) decreased white blood cells concentration compared to control group.

significantly (P<0.05) decreased Mean cell hemoglobin and increased Mean cell hemoglobin concentration, however neem leaves at 15% there were no significant differents Mean cell hemoglobin and Mean cell hemoglobin concentration, while there were decreased packed cell volume compared to control group.

Ogbuewu *et al.* (2015) founded that supplementation of neem leaves to rabbits diets at (5, 10 and 15%) neem leaves and indicated that there were no significant changes on Mean cell hemoglobin concentration and packed cell volume compared to control group.

Kyere *et al.* (2018) found that supplementation of neem leaves to pearl guinea fowls diets at (3, 6 and 9%) neem leaves significantly (P<0.05) increased packed cell volum perstage concentration on pearl guinea fowls blood compared to control group.

Nnenna and okey (2013) reported that supplementation aqueous neem leaf extract to broiler chicks water at (20, 40, 60) ml per1litre significantly (P<0.05) increased packed cell volum compared to control group.

Odunsi *et al.* (2009) found that supplementation of neem seeds on the cockerel chickens diets at 10% and 20% did not show any significant different compared to control group.

Oluwafemi and Oluwayinka (2020) found supplementation of different levels of neem oil at (0.1 , 0.2, 0.3 and 0.4%) to rabbits diets significantly (P<0.05) increased packed cell volum concentration on rabbits blood compared to control group.

3.10. Lymphocytes and Neutrophil

Ogbuewu *et al.* (2010) reported that supplemented neem leaves to rabbits diets at (5, 10 and 15%) neem leaves and observed that neem leaves at 5% there were no significant changes ,however at 10% neem leaves significantly (P<0.05) increased Lymphocytes ,while neem leaves at 15% significantly (P<0.05) decreased on Lymphocytes, although levels of Neutrophils significantly (P<0.05) decreased compared to control group.

4. Conclusions

This review summarises the wide range of pharmacological activities of neem leaf. Therefor, recent reaserch has proven great important for the application of neem and its products from leaves, flowers, fruits, oil and bark in animal nutrition.

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Consent for Publication
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The authors declare no conflict of interest.

5. References

Abdel-Wareth, A.A., Kehraus, S., Ali, A.H., Ismail, Z.S., Südekum, K.H. (2015). 'Effects of temporary intensive feed restriction on performance, nutrient digestibility and carcass criteria of growing male Californian rabbits', *Archives of animal nutrition*, 69(1), pp. 69-78.

Alimon, A.R. (2009). 'Alternative raw materials for animal feed',WARTAZOA. *Indonesian Bulletin of Animal and Veterinary Sciences*, 19(3), pp.117-124.

Bratte, L.I.O.L., Isikwenu, J.O.(2015). 'Effects of Graded Levels of Neem (*Azadirachta indica*) Leaf Meal on Egg Production, and Quality of Eggs of Shika Brown Layers', *Journal of Natural sciences Research*, 6(15), pp. 2224-3186.

Butcher, C., Bryant, MJ., Machin, D.H., Owen, E., Owen, J.E. (1981). 'The effect of metabolizable energy concentration on performance and digestibility in growing rabbits', *Trop. Anim. Prod.,* 6(2) , pp. 93-100.

Ekine, O.A., Samuel, M.B. (2020). 'Dietary effects of neem (*azadirachta indica*) leaf meal on broilers performance and serum biochemical indices', *International Journal of Contemporary Applied Researches,*13(6), pp. 1050–1055..

El-Zaiat, H.M., Alqaisi, O., Sallam, S.M., Al-Marzooqi, W.S. (2021). 'Effect of increasing doses of neem (*Azadirachta indica*) seed oil on feed intake, nutrients digestibility, ruminal fermentation and nitrogen utilization of Omani sheep', *Animal Biotechnology*, pp. 1-9 .DOI:10.1080/10495398.2021.1917422.

Grela, E. R., Semeniuk, V. (2006). 'Consequences of the withdrawal of antibiotic growth promoters from animal feeding'. *Medycyna Weterynaryjna*, 62(5), pp. 502-507.

Grela, E.R., Klebaniuk, R.E.N.A.T.A. (2007). 'Chemical composition of garlic preparation and its utilization in piglet diets', *Medycyna Weterynaryjna*, 63(7), pp.792-795.

Khalil, A.K.P. (2003). 'Antidiabetic and Antihyperlipaemic Effects of Aqueous Neem (*Azadirachta Indica*) Extract on Alloxan Diabetic Rabbits.', *Engineering and Technology International Journal of Chemical and Molecular Engineering*, 16(1).

Kharde, K.R., Soujanya, S. (2014). 'Effect of garlic and neem leaf powder supplementation on growth performance and carcass traits in broilers', *Veterinary World*, 7(10), pp. 799-802.

Klusek, J., Kolataj, A., Swiderska-Kolacz, G., Rafay, J. (1997). 'The levels of some lipids in the organs of rabbits during different ontogenesis periods.', *Archiv fuer Tierzucht* , 40(5), pp. 477-482

Kolacz, J. (1997). 'Measurement system of the mill charge in grinding ball mill circuits', *Minerals Engineering*, 10(12), pp. 1329-1338.

Kumari, P., Kumar, K., Kumar, S. (2014). 'Effect of dietary supplement of sugar beet, neem leaf, linseed and coriander on growth performance and carcass trait of Vanaraja chicken',*Veterinary World*, 7(9), pp. 639-643. DOI:10.14202/vetworld.2014.639-643.

Kyere, C.G., Twumasi, G., Seidu, H., Quaye, T. (2018). 'Influence of neem (*Azadirata indica*) leaf meal on growth performance and blood profile of the pearl Guinea fowl', *Livestock Research for Rural Development*, 30(2), Retrieved April 11, 2022, from http://www.lrrd.org/lrrd30/2/kyer30030.html

Landy, N., Ghalamkari, G.H., Toghyani, M. (2011). 'Performance, carcass characteristics, and immunity in broiler chickens fed dietary neem (*Azadirachta indica*) as alternative for an antibiotic growth promoter', *Livestock Science*, 142(1-3), pp. 305-309.

Nnenna, O.P., Okey, A.A. (2013). 'Toxicity and nutritional assessment of aqueous *Azadirachta indica* (neem) leaf extract in broiler chicks', *Int. J. Biosci.*, 3(6), pp. 172-180.

Odunsi, A.A., Adegbile, S.A., Akande, T.O., Olayeni, T.B. (2009). 'Neem (*Azadirachta indica*) seed cake in the diets of cockerel chickens', *International Journal of Poultry Science*, 8(1), pp. 47-51.

Ogbuewu, I.P., Ezeokeke, C.T., Okoli, I.C., Iloeje, M.U. (2015). 'Blood chemistry and relative organ weights of rabbits fed neem leaf meal based diets', *Nigerian Journal of Animal Production*, 42(2), pp.111-121.

Ogbuewu, I.P., Okoli, I.C., Iloeje, M.U. a (2010). 'Evaluation of toxicological effects of leaf meal of an ethnomedicinal plant-neem on blood chemistry of puberal

Chinchilla rabbit does', *Report and Opinion*, 2(2), pp. 29-33.

Ogbuewu, I.P., Uchegbu, M.C., Okoli, I.C., Iloeje, M.U. (2010). 'Assessment of blood chemistry, weight gain and linear body measurements of pre-puberal buck rabbits fed different levels of Neem (*Azadirachta indica A. Juss.*) leaf meals', *Chilean Journal of Agricultural Research,* 70(3), pp.515-520.

Ogbuewu, I.P., Uchegbu, M.C., Okoli, I.C., Iloeje, M.U. b (2010). 'Toxicological effects of leaf meal ethnomedicinal plant—neem—on serum biochemistry of crossbred New Zealand white typed rabbit bucks', *Rep Opin.,* 2(2), pp. 54-57.

Oluwafemi, R.A., Oluwayinka, E. (2020). 'Effect of Dietary Supplementation of Neem oil (*Azadirachta indica*) on the Growth performance and Nutrient digestibility of weaned rabbits.', *Journal of Science, Computing and Engineering Research*, 1(4), pp. 100-105.

Ozung, P.O., Kennedy, O.O.O., Ubua, J.A., Abekam, E. (2019). 'Dietary Cocoa Pod Husk Meal Could Influence the Reproductive Tract Morphometry of Rabbits', *East African Scholars Journal of Agriculture and Life Sciences*, 2(1), pp. 26-30.

Pla, M., Pascual, M., Ariño, B. (2004). 'Protein, fat and moisture content of retail cuts of rabbit meat evaluated with the nirs methodology', *World Rabbit Science*, 12(3), 149-158.

Seriana, I., Akmal, M., Darusman, D., Wahyuni, S., Khairan, K., Sugito, S. (2021). 'Neem Leaf (*Azadirachta indica A. Juss*) Ethanolic Extract on the Liver and Kidney Function of Rats', *The Scientific World Journal*, pp. 1-7. DOI: 10.1155/2021/7970424

Ubua, J.A., Al-Isah, W., Inuwa, I., Abdullahi, B.L., Ozung, P.O. (2019). 'Utilization of Neem Leaf Meal: Effect on growth response, haematology and serum biochemistry of rabbit does', *Global Journal of Agricultural Sciences,* 18(1), pp. 31-37.

Unigwe, C.R., Balogun, F.A., Okorafor, U.P., Odah, I.S., Abonyi, F.O., Olona, J.F. (2016). 'Effect of neem leaf (*Azadirachta indica*) meal on growth performance and haematology of rabbits', *World Scientific News,* 55, pp. 51-62.

Wenk, H.R., Johnson, L.R., Ratschbacher, L. (2000). 'Pseudotachylites in the eastern peninsular ranges of California', *Tectonophysics*, 321(2), pp. 253-277**.**

Yakubu, A., Salako, A.E., Ladokun, A.O., Adua, M.M., Bature, T.U.K. (2007). 'Effects of feed restriction on performance, carcass yield, relative organ weights and some linear body measurements of weaner rabbits', *Pakistan Journal of Nutrition,* 6(4), pp. 391-396.

Zuraini, A., Vadiveloo, T., Hidayat, M.T., Arifah, A.K., Sulaiman, M. R., Somchit, M. N. (2006). 'Effects of neem (*Azadirachta indica*) leaf extracts on lipid and C-reactive protein concentrations in cholesterol-fed rats', *Journal of Natural Remedies*, 6(2), pp. 109-114.