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Review Article

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Phytogenic Products: A Valuable Resources for Pig and Poultry Nutrition, Health and Management

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Abstract

Due to over bacterial resistance as well as ban of antibiotic growth promoters (AGP) in the European countries many alternative substances have been investigated for their potential to replace AGPs. Phytogenic products are also called phytobiotics or biologicals. Phytogenic products are one of the promising alternatives due to their high content of pharmacologically active compounds. There are various in vitro and in vivo studies have confirmed a wide range of activities in terms of phytobiotics in poultry and pig nutrition, gut health and management like stimulation of feed intake, antimicrobial, coccidiostatic and anthelmintic effects. The use of antibiotics and other allopathic as well as homeopathic medicines reduced day by day. This trends are observed due to people are more health conscious about the side defects, quality of food, cost of production, poultry health and welfare is an ever-growing demand for low-priced, high quality food, improved feed hygiene, greater poultry health and welfare, and reduced environmental health hazards. Now days, Researcher has focused more on the development of alternative strategies to maintain poultry and pig health and enhance performance with numerous natural substances, termed as natural growth promoters (NGPs) have been identified as effective alternatives to antibiotics. Phytogenic products or phytobiotics are natural growth promoters that have been growing in popularity as feed additives, due to their beneficial effect on gut health and immunity and growth performance along with no residual or side defect on meat and egg qualities.

Keywords: Health and Management; Poultry Nutrition; Valuable Resources for Pig.

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Introduction

Poultry and pig industry plays a vital role for income generation to the rural people as well as for socio-economic up-liftment of farming community. Tremendous demand for animal protein, high growth rate and prolific values has caused an expansion of broiler and pig farming in India. To achieve more profit and benefits from pig and poultry various natural growth promoters especially phytobiotics are used by the researchers as well as progressive farmers. The antibiotic growth promoters (AGPs) have been used extensively in livestock production for almost 50 years. Due to continuously public awareness towards potential health risks and environmental problems caused by the excessive use of synthetic pharmaceuticals including in-feed antibiotics as growth promoters, growth hormones and also public demand for organic foods have gradually changed the attitude toward these synthetic antibiotics (Greathead 2003; Rochfort et al., 2008).

Phytobiotics can be defined as the plant derived products added to feed in order to improve the growth and productive performances of specific or all livestock species. It may originate either from leaves, roots, tubers or fruits of herbs, spices and other plants. It may be available in solid, semi-solid, liquid, dried and ground forms, or as extracts (essential oils). In simple terms, phytobiotics are products of plant origin and preparations such as thyme, oregano, turmeric, tulsi, sea buckthorn, gilloy and garlic are gaining interest among researchers and poultry and pig producers. The beneficial effects of phytobiotics in poultry and pig may arise from the activation of feed intake and the secretion of various digestive enzymes, immune stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity or antioxidant properties for the welfare of farm animals. Plant's secondary metabolites, such as isoprene derivatives, flavonoids, flavones and glucosinolates, may act as antibiotics or as antioxidants in vivo also, as a result of these beneficial effects, they lead to an increase in performance. There are various potential effects of phytobiotics on immune function can be mediated either by alterations of the composition of the gut microflora or by direct effects on the gut associated general immune system. Phytogenic feed additives are often called as "Phytobiotics" or "botanicals". It can be commonly defined as plant-derived compounds incorporated into diets to improve the productivity, health and nutrition of livestock as well as quality of products through amelioration of feed (Windisch et al., 2008).

The phytogenic feed additives may present in seeds, leaf, root, or bark of the herbs and the active content of biologically active components or alkaloids may vary widely, depending on the plant parts used. Plenty of studies have been done using phytobiotics in poultry and swine nutrition which mostly shown the antimicrobial, antioxidant, anti-inflammatory and growth promoting effects of phytobiotics (Panda et al., 2006). Anti-oxidative properties of phytobiotics can positively affect the stability of animal feed and increase animal's products quality and storage time.

Specifications of Phytogenic Substances

Leaves, roots, flowers and whole plants are used for production of phytogenic products. Products may comprise the dried form of whole plants or their parts or extracts of some valuable ingredients. In general, phytobiotics are described by primary and secondary plant compounds (Fig. 1).

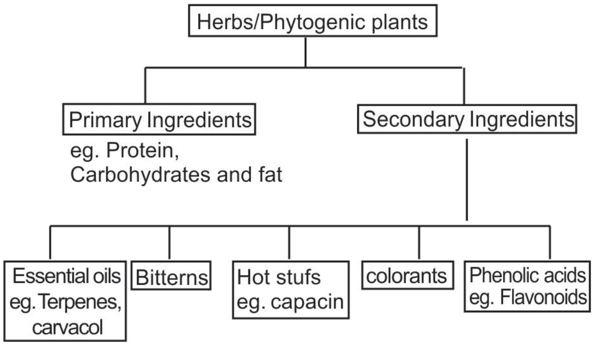

Fig. 1: Herbs phytobiotics are described by primary and secondary plant compounds.

Primary compounds are main nutrients (e.g., content of protein, fat, etc.), whereas, secondary compounds comprise essential (ethereal) and/ or volatile oils, bitterns, hot stuffs, colorants and phenolic compounds (Wald, 2003). In general, phytobiotics do not add significantly to the intake of main nutrients in poultry. Therefore, secondary plant compounds are the main ingredients of interest. The main constituents of essential oils are lipophilic, liquid and volatile and belong to chemical groups of alcohols, aldehydes, esters, ethers, ketones, phenols and terpenes.

Beneficial Effects of Phytobiotics

The beneficial effects of phytobiotics in poultry and pig may arise from the activation of feed intake and the secretion of digestive enzymes, immune stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity, or from antioxidant properties. Many plant secondary metabolites, such as isoprene derivatives, flavonoids and glucosinolates, may act as antibiotics or as antioxidants in vivo. As a result of these beneficial effects, they lead to an increase in performance.

Improvement in Feed Consumption and Digestive Enzymes

Addition of herbal supplement in the feed as a flavor enhancer, therefore influence eating patterns and feed consumptions in pig and poultry. The secretion of digestive fluids and total feed intake is often considered to be one of the important actions of phytobiotics. The most of the herbs develops their initial activity in the feed as flavor and therefore it influences eating patterns or eating behaviour, secretion of digestive fluids and total feed intake of animals. Due to stimulation of digestive secretions, including saliva, digestive enzymes, bile and mucus is often considered as one of the important actions and benefits of phytobiotics. A product from the rhizomes of Sanguinaria canadensis is frequently used in Europe for poultry and pig while garlic and horseradish, when included in feed, stimulate the production of saliva and gastric juices. Turmeric, a powder derived from the rhizome of Curcuma longa has been shown to improve feed intake in poultry when used at 0.25% in feed as well as reduce the occurrences of coccidiosis and other diseases of bacterial and protozoal origin. The CPDO, Hyderabad, has shown that 0.25% inclusion of turmeric powder in the diet of broiler chicken significantly increased the body weight gain at five weeks of age. It has been mostly reported that addition of herbal products to diets has growth promoting effect on poultry and swine (Wenk 2003; Kim et al., 2010; Mohammadi Gheisar et al. 2015a, b). The performance of pigs fed with the diets supplemented with essential oils and reported weight gain and digestibility of dry matter and crude protein were improved by 10.3, 2.9 and 5.9%, respectively (Li et al., 2012). They observed that improved performance of pigs was due to improvement in the intestinal morphology and consequently improvement of nutrients digestibility. Yan et al. (2010) also found that growing-finishing pigs with diet supplemented with essential oils (thyme, rosemary, oreganum extracts) and reported that the average daily gain (ADG) and feed conversion ratio (FCR) significantly improved during the growing period. Stimulating the secretion of digestive enzymes, improving palatability and flavour of feed, increasing feed intake, and increasing antimicrobial activity are some of the main modes of action that might have led to the improved growth performance of poultry and swine (Jang et al., 2004; Czech et al. (2009). Singh et al. (2016, 2019a,b,c) also reported that supplementation of sea buckthorn leaf meal in coloured breeder bird and broiler chicken improves the FCR, egg production, growth rate, health condition etc.

Yan et al. (2011) have reported that adding a herb extract blend (containing buckwheat, thyme, curcuma, black pepper and ginger) to the diet of growing pigs resulted in increases in average daily feed intake (ADFI) and final body weight. Mohammadi Gheisar et al. (2015a) reported that feeding broiler chickens with diet containing 0.075% of a phytogenic blend led to 3.9% and 3.4% improvement in BWG and FCR, respectively. Results of some studies have shown that feeding pigs with essential oils extracted from fennel and caraway or extracted from thyme and oregano resulted in dose-related detrimental effect on palatability (Schone et al., 2006). Some other reports have shown that addition of phytobiotics to the diet of broiler chickens and laying hens resulted in significant depression in feed intake (Roth-Maier et al., 2005). On the other hand, there is evidence showing improvements in feed intake by adding PFA to swine diet (Kyriakis et al., 1998).

Antimicrobial and Coccidiostatic Properties

Phytogenic products can selectively influence microorganisms through antimicrobial activity or by a favoruable stimulation of the eubiosis over the microflora. This leads to better utilization and absorption of nutrients resulting in higher performance. Various plant extracts, especially essential oils, have been studied for their antimicrobial properties. Most research carried out in this area has been conducted in vitro, but there have been a few studies with live poultry flocks. Phytogenic substances derived from oregano (Origanum vulgare), especially the major active substances thymol and carvacrol, are known to exert antimicrobial and bacterial actions in vitro, while eugenol, a component of the essential oil from cloves, has been shown to inhibit Salmonella typhimurium. Blends of oil containing thymol, eugenol, curcumin and piperin could be used to control Clostridium perfringens, the bacterium that causes necrotic enteritis in broiler chickens. Essential oil from cinnamon has been shown to improve the digestibility of nutrients in poultry, while polysaccharides from mushroom (Tremella fuciformis) and the herb Astragalus membraneaceus have demonstrated promises responses in controlling experimental coccidial infections. Directorate of Poultry studies into the effects of turmeric found that the addition of 0.2% to broiler diets resulted in a significant reduction in Escherichia coli count.

Immuno-modulatory Effect

The herbal plants are rich source of polysaccharides and also contain phenolic acids, tannins, flavonoids, glycosides, and terpenes. The polysaccharides derived from many herbsal plants plays an important role in stimulating the growth of immune organs, such as the spleen, thymus and bursa which helpful in increasing the number and activities of T, B lymphocytes, macrophages, natural killer (NK) cells and increasing cellular as well as humoral immune responses of pig and poultry. It is also proved that dietary addition of 200 g turmeric per quintal of feed significantly increased antibody production in response to sheep red blood cells (1%SRBC) inoculation of chickens. It was observed that the persistency of antibody titer was better in birds fed turmeric in the diet in comparison to control or basal diet.

Antioxidant Activity

The antioxidant properties of phytogenic compounds such as α-tocopheryl acetate or butylated hydroxytoluene are very helpful in protection of dietary lipids from oxidative damages (Nakatani, 2000). The major role of phyto-antioxidants in poultryand pig meat production is only on to check lipid oxidation in meat and meat products. The plant oils containing natural antioxidants contribute to the improved oxidative stability of meat and meat products containing higher levels of polyunsaturated fatty acid. These antioxidants are manily tocopherols, however phenols, present in appreciable amounts in olive oil, are effective non-tocophenol antioxidants. Placha et al. (2014) have demonstrated that supplementing the diet of broiler chickens with thymol can reduce the oxidation of fatty acids indicated by the lower malondialdehyde level in duodenal mucosa. Phytobiotics can beneficially affect some antioxidant enzymes such as glutathione peroxidase and superoxide dismutase, consequently affecting lipid metabolism in animals (Franz et al., 2010). Other plant species such as ginger, curcuma, anise, coriander and plants that are rich in flavonoids or anthocyanins (e.g. many fruits) also have antioxidant activities (Nakatani 2000; Wei and Shibamoto 2007). There is also evidence showing that black pepper (Piper nigrum), red pepper (Capsicum annuum L.) and also have antioxidant activities (Nakatani 2000).

Anti-inflammatory Response

Some metabolites or essential oils viz. rosmarinic acid, oleanolic acid and ursolic acid are the major nonvolatile secondary metabolites found mainly in Origanum spp having anti-inflammatory responses (Shen et al., 2010). Other essential oils from eucalyptus, rosemary, lavender, millefolia and other plants (pine, clove and myrrh) have been generally used in mixed formulations as anti-inflammatory drugs (Darsham and Doreswamug 2004).

Conclusions

In present scenario, the poultry and pig meat production and management faces several challenges viz. climatic change, changes of feed, microbial load, stress during rearing disturbing the normal functioning of the livestock especially pig and poultry. The gastrointestinal tract may be influenced resulting in impaired absorption of nutrients resulting in reduced performance and increased mortality and morbidity cases. Therefore, with the ban of antibiotics as in feed growth promoters farmers lost an effective tool to help poultry and pig to perform better growth, production and reproductive performances. Phytogenic products such as thyme, oregano, turmeric and garlic are gaining interest among researchers and poultry producers. In these conditions, Phytogenic products seem to be the most promising ones as they are of natural origin and as they are generally regarded as safe. These phytogenic products plays a significant contribution for improving growth performance and health status as well as productive and reproductive performances. So, addition of phytogenic products in the diet of pig and poultry will be helpful for improving the performances health and nutrition as well as to improve the socio-economic status of the farmers.

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Review Article

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Feeding Strategies and Manure Management to Mitigate Green House Gas (GHGs) Emission in Dairy Farms

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Abstract

Basic aims of livestock rearing are production and harvest more and more profit margin. Nutrition (Balanced ration), along with manage mental, gynaecological and medicinal inputs helps to enhance the profitability through livestock rearing. Nutrition is foremost important and significantly higher input cost in livestock rearing and surely influential and deciding factor of profitability. Gaseous loses from overall nutritional inputs is significant lose of input and hazardous to climate safety. Thus, article proposed to elaborate various feeding strategies to minimize the gaseous loses, enhance climate safety and deliver more and more profit towards livestock owners.

Key words: Nutrition, Green house gases, Climate safety.

Introduction

Net GHGs emissions from India in 2007 were 1727.71 MT of CO_2 equivalents, out of this livestock and manure emitted about 212.10 MT of CO_2 eq. GHG (INCCA, 2010). Methane is a potent greenhouse gas and comprises up to 16% of the total GHGs emission (Scheehle and Kruger, 2006). Total GHGs emissions from livestock globally estimated as 7.1 GT (18%) CO_2 eq. (Steinfeld et al., 2006). Global atmospheric CH_4 conc. increased by 150% from 722 ppb in 1750 to 1803 ppb in 2011 (IPCC, 2013). (Fig. 1 and 2)

Thus, we urgently needed to elaborate various plans/strategic measures to overcome such environmental issues, as such things might be catastrophic consequences for upcoming generation and. Scientist and researchers are trying to manipulate conventional feeding system to beneficially affect rumen environment, lower down dietary loses and eco-friendly animal husbandry.

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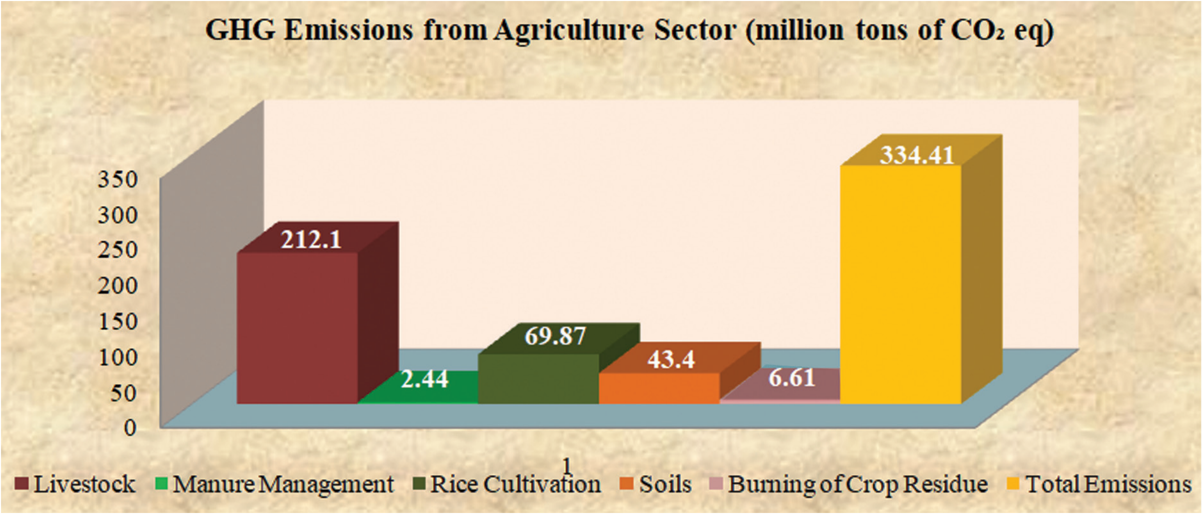

Fig. 1 Partitioning of GHGs from agriculture and its allied sectors. (INCCA, 2010)

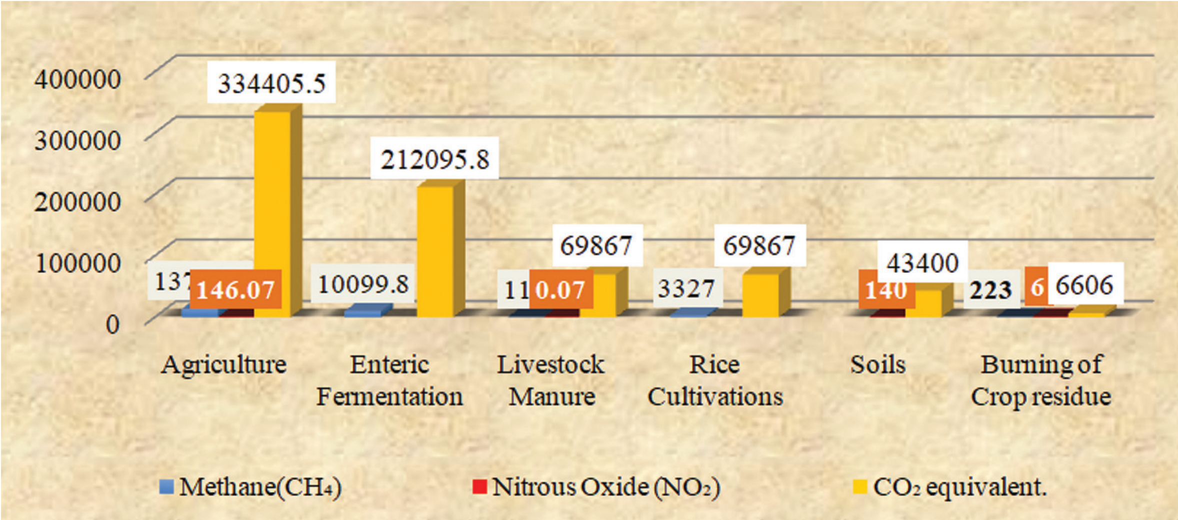

Fig. 2 Greenhouse Gas Emissions by Sources and Removal by Sinks from India in 2007 (Thousand tons). (INCCA, 2010)

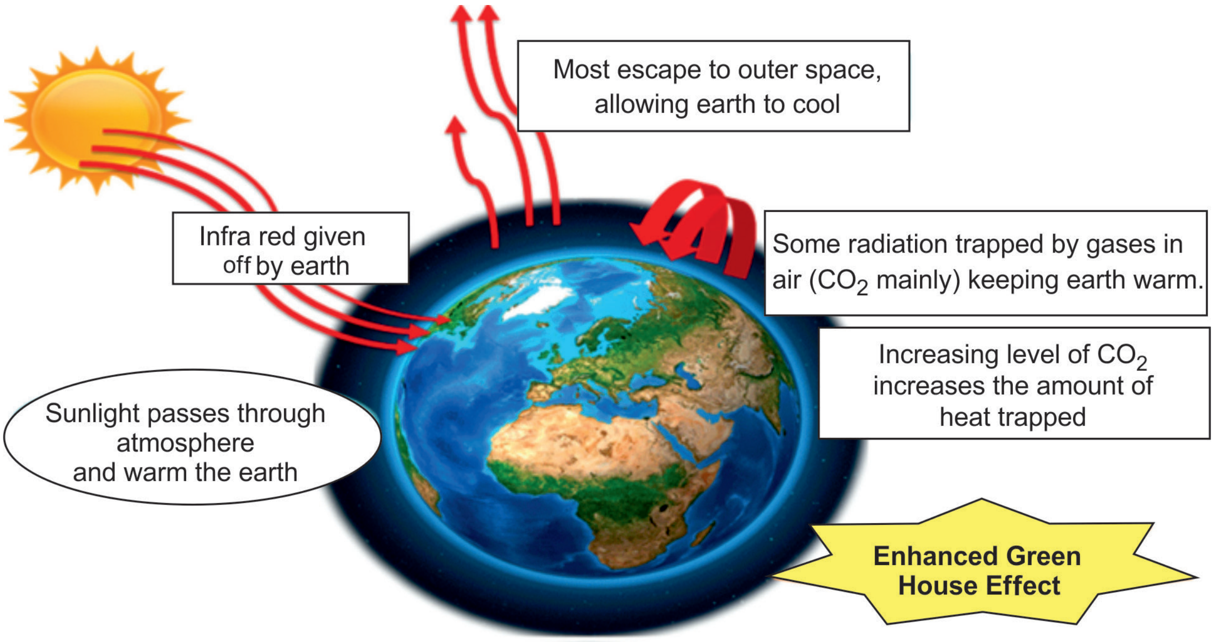

Fig. 3 Green House Effect on Earth. (INCCA, 2010)

Table 1: Major Green house gases and its contribution

Gas	Current Conc. (ppm)	Rate of increase (%/yr)	Half Life (yr)	GHG Contribution (%)
CO_2	391	0.5	150	55 – 60
CH_4	1.8	0.7	7-10	15 – 20
N_2O	0.32	0.2	150	5

(IPCC, 2013)

Table 2: Methane Production by Dairy Animals

Species	Enteric Fermentation Emission (Tg)	Manure Management Emission (Tg)	Total Emission (Tg)
Dairy Cattle Indigenous	2.32	0.289	2.61
Cross-bred	0.84	0.074	0.92
Total	3.16	0.363	3.53
Non Dairy Cattle Indigenous	2.12	0.208	2.33
Cross – bred	0.11	0.01	0.12
Total	2.23	0.218	2.45
Dairy Buffaloes	4.06	0.371	4.441
Non dairy Buffaloes	0.44	0.055	0.490

(Chhabra et al., 2009)

Strategies to Mitigate Enteric Methane Emission

1. Inhibitors
2. Electro receptors
3. Ionophores
4. Dietary lipids
5. Exogenus enzymes
6. Direct fed microbial
7. Defaunation
8. Feed intake
9. Concentrate inclusion
10. Forage quality
11. Feed processing and feeding frequency
12. Plant bio-active compounds

Inhibitors

Bromoethanesulphonate (BES) is a potent inhibitor of methanogenesis because it is a structural analogue of the cofactor mercaptoethanesulfonic acid (coenzyme M), used by methanogenic bacteria (Mathison et al., 1998). BES depressed CH4 production by 71% without significantly affecting organic matter digestibility and VFA concentrations

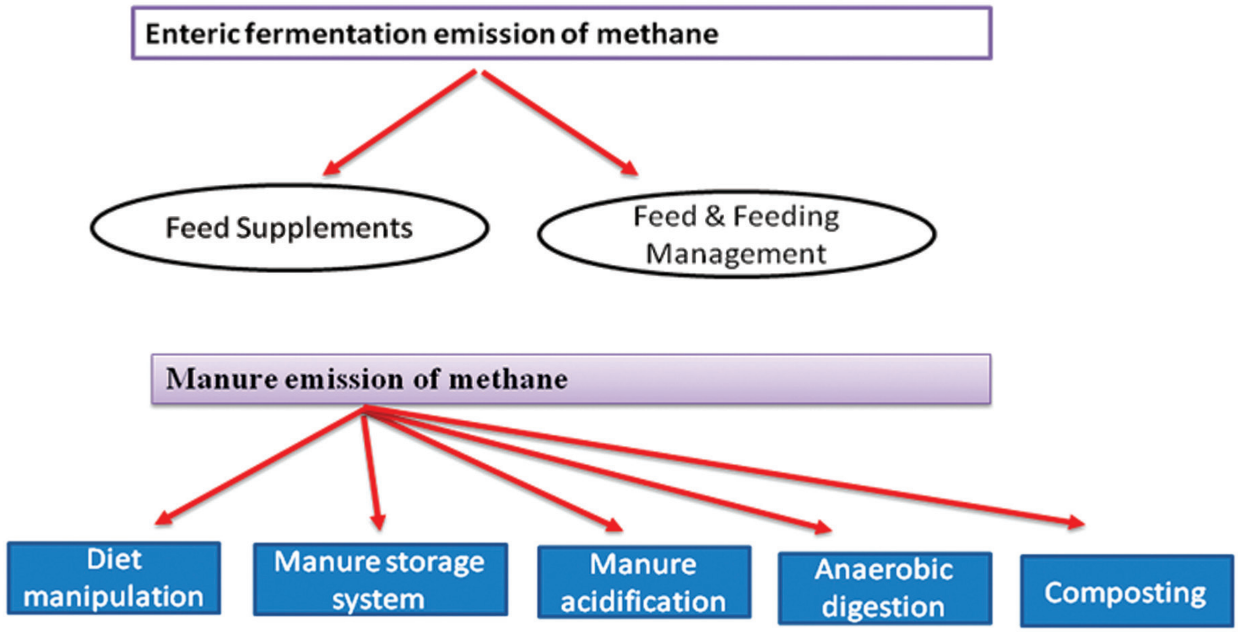

Fig 4. Enteric and Manure Emission of GHGs.

(Source: Personal)

in the artificial rumen (Dong et al., 1997). Bromochloromethane (BCM) and Cyclodextrin reduce 50% of CH_4 production (Mitsumori et al., 2011). (Fig. 4 and 5)

Table 3: Concentrate Roughage Ratio

Concentrate	Roughage	Propionate (%)
25	75	23.33
50	50	30
75	25	35.66

(Singh & Mohini.,1993).

Electron Receptor

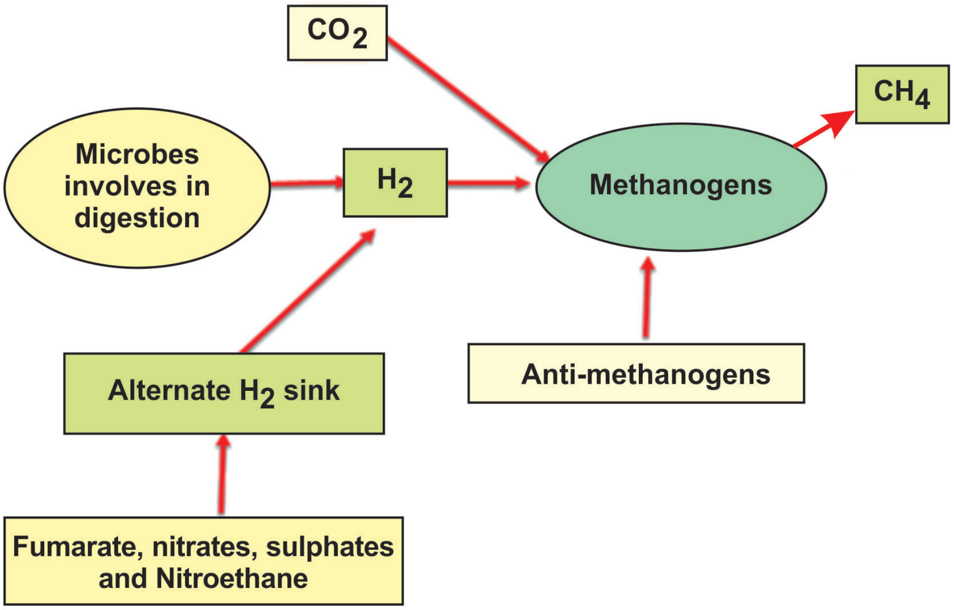

Fig. 5: Influences of Electron Receptors on GFGs Emission.

(Source: Personal)

Ionophores

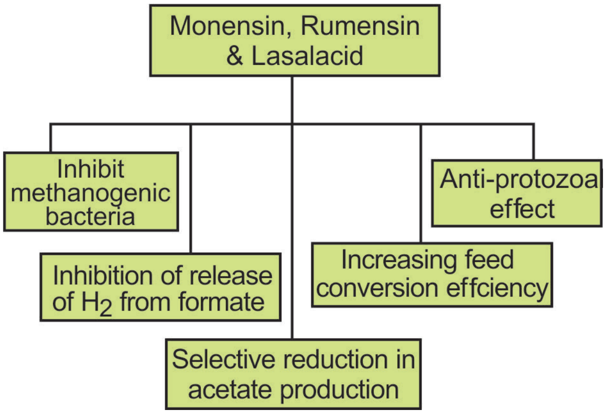

Fig. 6: Different Pathways to Control GHGs.

(Source: Personal)

Methane production reduced from 40.9 to 28.0 lit/Kg DM due to the increase of concentrate mixture from 25% to 75% in wheat straw based diet (Singh & Mohini.,1993). (Table 3 and Fig 6)

Dietary Manipulation

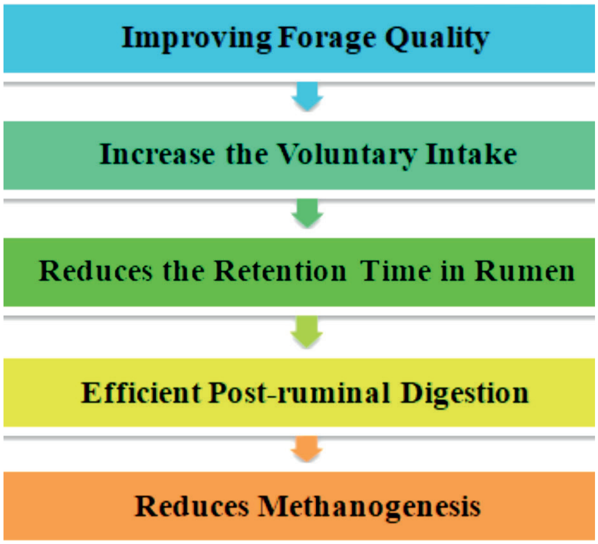

Fig. 7: Influences of dietary quality on GHGs emission

(Hess et al., 2011)

Plant Bioactive Compounds (PBAC)

This category includes a variety of plant secondary compounds, specifically tannins, saponins, essential oils and their active ingredients.

Tannins

Condensed tannin form complexes with dietary proteins and carbohydrates in the rumen (pH = 7.0). Thus, reducing digestibility of DM and organic matter (OM) and the release of H2 (indirect effect) (Jayanegara et al., 2011) (Fig. 8)

- Two forma of tannin occurs, naturally

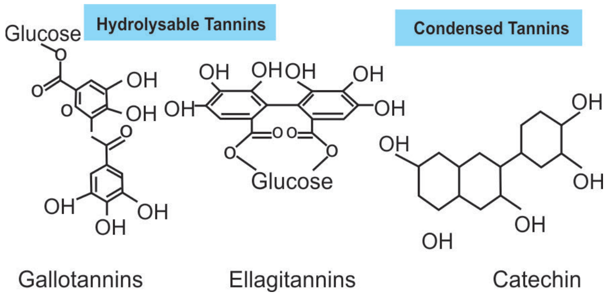

Fig. 8: Chemical Structures of Tannin.

(Patra et al., 2010)

Saponin

Suppress enteric CH_4 production due to their ability to reduce Protozoal numbers and modify fermentation patterns in the rumen (Meale et al., 2012). 54% decrease in protozoa counts and a 20% decline in in vitro CH_4 production when supplementing saponins at 12 mg/g DM (Rejil et al., 2008). Singh et al. (2017) investigated blend of saponin rource, Sapindus mukorosii alongwith Ficus bengalensis and Eucalyptus globus essential oil under In vitro environmental conditions and reported significantly ($P<0.001$) reduced methane emission in treatment group, as compared with control group. They suggested influenced beneficial microbial population, enhanced propionate production and suppressed ruminal degradability of feed might be the cause of methane inhibition. Singh et al. (2018) In vitro examined natural saponin from Sapindus mukorosii in various cumulative dose regimens and reported significantly reduced methane production, as compared with control group. They suggested enhanced propionate production leads to methane inhibition.

Essential Oils

Anti-microbial activities against Gram-positive and Gram-negative bacteria, attributed to a number of terpenoid and phenolic compound (Sivropoulou et al.,1996). Singh et al., (2018), investigated Cymbopogon citratus essential oil for its effect on methane inhibition and various other ruminal parameters and reported highly inhibition of methane production, even though very low dose incubation (@10µl/40ml of rumen fluid) (Fig. 9)

Defaunation

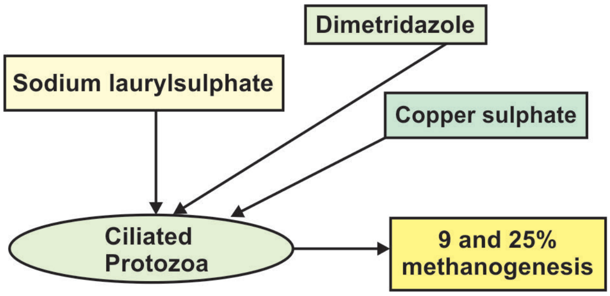

Fig.9 Influences of defaunation on GHGs emission.

(Boadi et al., 2004)

Immunization

Methanogenic specific vaccine 1st developed by Australian researchers reduce 7.7% methane emission (Wright et al., 2004). Canadian researchers prepared IgY antibodies in chicken eggs against three species of methanogens (Cook et al., 2008). Identified several gene targets to inhibit CH_4 in M.ruminantium via chemogenomic and vaccine is prepared (Leahy et al., 2010).

Use of Bacteriocin

Bovicin HC_5, a bacteriocin produced by Streptococcus species from the rumen, was reported to suppress CH_4 production in vitro by 50% (Lee et al., 2002)

Use of Probiotics

Probiotics are 'live microorganisms' which when administered in adequate amounts confer a health benefit on the host. (Saccharomyces cerevisiae & Aspergillus oryzae) (Lascano & Cardenas, 2010).

Mitigation of manure (CH_4 and NO_2) Emission

Dietary Manipulation

Feeding dairy cows low-protein diets dramatically reduces the proportion of urinary, particularly urinary urea N (> 50 %) in animal excreta (Misselbrook et al., 2005).(Fig. 7)

Manure Acidification

Moderate decrease in manure pH through acidification significantly reduces NH_3 volatilization and CH_4 losses from stored manure (Petersen and Sommer, 2011).

Composting

Composting is an exothermic, aerobic process of microbial decomposition of organic matter. It influences significant loss of CO_2, N and reduce CH_4 emission (Husfeldt et al., 2012).

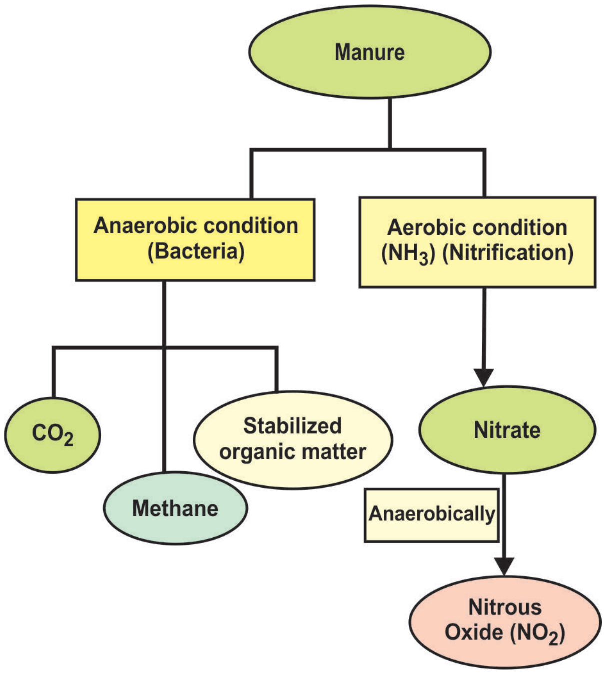

Fig.10 GHG_S mitigation through manuring.

(Source: Personal).

Nitrification Inhibitors

Nitrification inhibitors are chemical compounds that inhibit the oxidation of ammonia to nitrate in soils and thus reduce N_2O emissions from NH_4 (Di and Cameron, 2002). eg. Nitrapyrin, Hippuric acid and Dicyandiamide (DCD)

Anaerobic Digestion

Mechanism of Biogas production

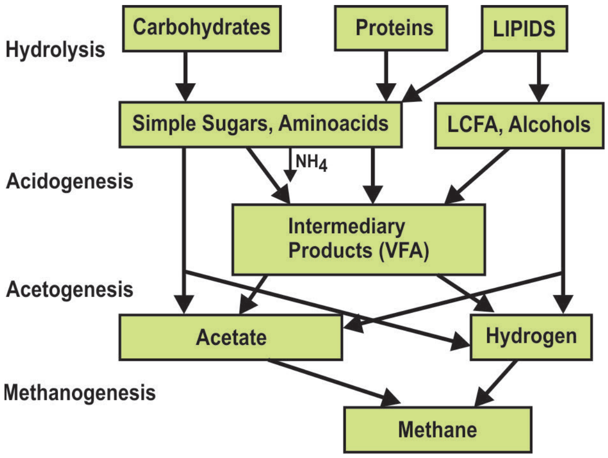

Fig.11 Mechanism of Bio-gas Production.

(Gujer and Zehnder, 1983)

Manure Applications

- Lowering the concentration of N in manure
- preventing anaerobic conditions or reducing concentration of degradable manure C
- Timing of the manure application and maintaining soil pH above 6.5 may decrease N_2O emissions
- Subsurface injection of manure slurries into the soil can result in localized anaerobic
- Conditions surrounding the buried liquid manure, higher CH_4 emissions than with surface applied manure

(Amon et al., 2002)

Grazing Management

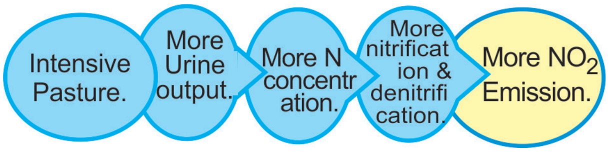

Fig. 12 Pathway of GHGs emission through improper grazing management.

(FAO, 2013)

Conclusions

- Mitigation of CH_4 emissions can be effectively achieved by strategies that improve the efficiency of animal production, reduce feed fermented per unit of product, or change the fermentation pattern in the rumen.
- Strategies that are cost effective improve productivity and have no potential negative effects on livestock production hold a greater chance of being adopted by producers.
- These new strategies are promising, but more research is needed to validate these approaches and to assess in vivo their effectiveness in reducing CH_4 production by dairy cows.
- Adjustment of manure storage systems involves high investment cost and high cost per unit of emission reduction and may not be adopted easily.

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Review Article

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Climate Change and Ageing

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Abstract

Climate change and an ageing population are crucial policy challenges which need to be addressed to ensure a safe, secure, equitable and sustainable future. Older people want to be part of the solution and to provide advice and guidance on what could be done to address climate change. Older people are especially vulnerable to some of the negative impacts of climate change. They form a large and growing group in society that needs an explicit policy response to minimize risk and vulnerability. There is an urgent need to exploit synergies between climate change policies and policies aimed at older people and to avoid overlaps and contradiction. This article briefly reviews the policy that can produce significant gains in quality of life for older people and at the same time contribute to reducing carbon footprints.

Keywords: Climate change, Ageing, Ecological footprint, Older people, Adaptation policies.

Introduction

Population ageing and climate change are the two most pressing issues now a days, yet there have been little attention given to the relationship between the two or the role of the built environment in eliminating intensifying effects. Heat waves pose the most immediate threat to public health and ageing. Older people, because of a range of physiological, psychological and socio-economic dispositions, are more vulnerable to the impacts of climate change and extreme weather events. Climate change and an ageing population are crucial policy challenges which need to be addressed to ensure a safe, secure, equitable and sustainable future. Despite there being a vast amount of literature dealing with the effects of global climate change on one hand and the repercussions of population ageing on the other, very little study exists addressing the compounding impact resulting from these occurring simultaneously. The purpose of this paper is to bridge the knowledge gap between the impacts of climate change, the vulnerabilities of older people and how the built environment can influence levels of resilience through adaptation.

A Changing Climate

Climate change is defined as a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended duration, typically decades or even longer (IPCC 2007). Climate change is anticipated to result in an increase in average temperature. The Intergovernmental Panel on Climate Change (IPCC) predicts an increase of 1.8–4.0 ºC(3.2–7.2 ºF) by the end of the century.

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Besides, the world's population is predicted to grow, and with it, primary energy demand and emissions output globally are also expected to rise. Recent analysis by the International Energy Agency (IEA) estimated that between 60 – 80% of the world's energy use currently emanates from cities and urbanized areas (IEA 2008) reflecting the fact that 50% of the world's population now reside in these environments (OECD2009). By 2050 the OECD forecasts, based on the current trend of urbanization particularly in the developing economies, that this percentage will increase to 70%, while in developed economies 86% of the population will be living in cities (OECD 2010). In terms of climate change, continued urbanization (again predominately within the developing economies) will increasingly shift the world's reliance from CO_2 neutral energy sources (biomass and waster) to CO_2 intensive energy sources, leading to continued growth in greenhouse emissions from cities (OECD 2008).

Consequences of Global Climate Change

In addressing the impacts of global climate change, the Copenhagen Accord set the target of limiting global temperature increases to two degrees Celsius relative to pre industrialized temperatures. However, even a two-degree increase in global temperatures will result in significant impacts that are likely to disrupt ecological and social networks alike. At a global scale, such impacts will include (IPCC 2007):

- melting of the polar ice sheets resulting in sea level rise;
- disruption to food supply and water resources;
- damage to physical infrastructure;
- increased public health risks; and
- modified global biogeochemical cycles, as well as oceanic and atmospheric circulation patterns.

Many of the world's largest cities (and therefore concentrations of economic activity and production) are located in coastal areas, historically linked to sea-port development, and will therefore also be vulnerable to sea level rise and storm surge; and represents unprecedented risk to livelihood, property and urban infrastructure within the developed economies (OECD 2010).

Climate change has direct as well as indirect effect on individual health. Direct impacts include injuries and death caused by extreme weather events such as flooding, bushfire and cyclones[6] (Greenough et al., 2001). Indirect impacts include changes in incidences of chronic disease and illness, resulting from changes in temperature, food and water supply, pollution levels as well as the habitat of vectors impacting disease transmission (Haines et al 2006, Bernard and Ebi, 2001).The consequences of climate change to human health are likely to be significant, (DARA, 2010) predicating a 145% increase in human mortality rate between 2010 and 2030 directly attributable to climate change. The Global Humanitarian Forum (2008) estimates that approximately 300,000 deaths per year are caused by weather-related disasters and gradual environmental degradation due to climate change and that this figure will rise to 500,000 by 2030. In addition, many of these health impacts will particularly affect those with pre-existing health conditions or weakened immune and metabolic resistance as a result of age, meaning those who are very young and older will likely be more vulnerable (McMichael and Woodruff, 2006)

Contributor of Climate Change

Changing climate with accelerated warming of global temperatures is directly attributed to human activity (IPCC 2007).The majority of the world's scientists now agree that it is at least 90 per cent certain that human emissions of green house gases (GHGs) rather than natural variations are warming the planet's surface (IPCC,2007). During the 20th century, the world population grew approximately fourfold, accompanied by a 12-fold rise in worldwide emissions of carbon dioxide (Haines et al., 2006) primarily due to fossil fuel use and land use change. Similarly the rise in methane and nitrous oxide within the atmosphere has been the result of increased agricultural production (IPCC 2007). In an increasingly globalised, industrialized and interconnected world, human activity continues to drive environmental degradation. The rate and scale of human-induced global environmental change is so noteworthy that it now constitutes a novel geological era in the Earth's history called the Anthropocene (Zalasiewicz et al., 2011; Steffen et al., 2011).

Concept of Ecological Footprint

An individual's pattern of consumption changes eventually reflecting wealth, age, health and social needs. The biggest environmental impacts of day-to-day individual actions are associated with housing, food, energy and individual travel (Gronco and Warde, 2001, Spangenberg and Lorek, 2002). These activities generate waste and polluting emissions that are a major cause of environmental degradation and contribute to global climate change (Zacarias-Farah and Geyer-Allely, 2003).

Since the 1970s, humanity's Ecological Footprint has doubled. In 2008 the Footprint exceeded the Earth's biocapacity (the area actually available to produce renewable resources and absorb carbon dioxide) by more than 50 per cent. It would take 1.5 years for the Earth to produce the resources humanity consumes in a single year. This 'ecological overshoot' is largely attributable to the carbon footprint, which has increased eleven-fold since 1961. Carbon emissions in particular together with food demand, are the major drivers of the escalating Footprint (WWF, 2012).

Ageing and Climate Change

Climate change is expected to have adverse effects on natural and human systems. Older People may be physically, financially and emotionally less able to deal with the effects of a changing climate compared with the rest of the population. The insecurity and heightened exposure to certain threats caused by a changing climate are compounded in old age by reduced capacities for coping independently. Older people can be considered as potential contributors to, and casualties of, climate change and potential campaigners to deal with the crisis.

Global Ageing

Ageing is a fact of life. The reality is that ageing is the progressive functional decline or a gradual deterioration of physiological function over time, including a decrease in reproduction, until death18 (Partridge and Mangel., 1999).The world is ageing rapidly and will continue to do so over the coming century. The contribution of those aged 55-plus rose from 12 per cent of the world's population (approx. 300 million) in 1950 to 16 per cent in 2010 (1 billion). By 2050 there will be a dramatic increase in the number of over 55s who will represent nearly a quarter (just over 2.5 billion) of the global population. Ageing is a accomplishment of progress and enhanced health systems, however, people also retain noteworthy vulnerabilities as they age.

Classification of old age group:

Baby boomers have a higher carbon footprint compared to other age groups. The term baby boomer is used here to refer to individuals aged 50–64 years. They are re-inventing old age basing it on new consumption and leisure orientated lifestyles, where travel and cosmopolitanism are key features (Leach et al., 2007).They are highly car dependent, with car use representing 71per cent of all trips made by this group. On average baby boomer individuals have a carbon footprint of approximately13.5 tonnes, and emit 1.5 to 2.5 tonnes more CO2 per year than any other age group (Haq et al., 2007).

Car trips represent 68 per cent of all trips for seniors (those aged 60-69 years of age) (DfT, 2005). Like the baby boomers, they enjoy travelling. Seniors have the second highest footprint compared to other age groups. A senior has a carbon footprint of approximately12.1 tonnes of CO_2 per year.

Elders (aged 75 plus) share many of the characteristics of the seniors. They are aware of their own mortality and the concept of death. They are coping with increasing care needs and declining health. They have the highest climate impact per pound spent compared to all other age groups. Their CO_2 emissions from energy use in the home are 40 per cent higher than the national average. This is partly due to smaller household occupancy and the fact that older people tend to remain at home with a high demand for warmth. As people get older they reduce their CO_2 emissions from transport. This reflects a decline in their physical mobility and rising dependence on public transport. Those aged 70-plus undertake 10 per cent of trips by bus and 60 per cent by car compared to 4 per cent and 71 per cent respectively for those aged 50-59 (DfT, 2005).

Vulnerability of older people to climate change

As people grow older they are increasingly faced with declining health and physical strength, disability, loss of income and bereavement. The impacts of climate change such as high temperatures, storm damage, as well as meager access to public services due to severe weather events may create a threat to the quality of life of older people. Some threats are linked to life stage such as decline in health and physical strength, disability, loss of income, loss of a spouse or members of a social network. Thus, healthy lifestyles, coping skills, strong family and social ties, dynamic interests and of course, savings and assets, will all help in ensuring that people's reserves are and stay strong in later life.

Conceptualising vulnerability to climate change

The IPCC Third Assessment Report defines vulnerability to climate change as "a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity" (IPCC 2001).

Functional age results from measuring performance on a range of measures or tasks which reflect various social, biological and psychological aspects (Hayslip and Panek, 1993). How an individual will cope with climate-related threats will be determined by their functional age and life stage. Vulnerability is the threshold between successfully adapting and coping with climate events and not being able to do so. Vulnerability of older people to the effects of climate change arises from a combination of personal characteristics and interactions between exposure, sensitivity and coping capacity when faced with a specific climate related threat. Exposure level, likelihood and extent of the risk and the diverse coping capacities will all decide the severity of the outcome (Schroder-Butterfill and Marianti, 2006).

Effects of Climate Change on Older People

Climate change will affect key areas which have particular relevance in determining the quality of life of older people: health, social services, housing, transport and cost of living.

Extreme Weather Events

Climate change will likely affect the frequency, severity and duration of extreme weather events such as tropical cyclones including storm surge, flooding and severe storms, as well as alter the geographic regions affected by them. Extreme weather can be defined as "meteorological events that have a significant impact upon a local community or ecosystem" but which are also "a departure from what is considered the norm" (Greenough et al., 2001). Extreme weather events have their potential to destroy and damage buildings and infrastructure. These events also pose significant public health risks, not only through traumatic death or injury during the event, but also indirectly as a result of the disruption to social and ecological systems, which will occur during the post-disaster recovery phase.

1. *Health*

The physical and social well-being of older people will be affected directly and indirectly from a changing climateOlder people, especially women aged 75-plus, those living on their own or in a care home, are at particular high risk of being affected during a heat wave as well as those with chronic and severe illness including heart conditions, diabetes, respiratory or renal insufficiency, Parkinson's disease or severe mental illness. Individuals who have Alzheimer's, a disability or being bed bound may be affected due to their inability to adapt behavior to keep cool. In addition, environmental factors (e.g. living in a top floor flat) and over exposure (e.g. doing work out doors) can increase the risk of being affected (NHS, 2007a; 2007b; 2007c).Regulation of the body's temperature can be impaired in the elderly and chronically ill, and those who may take certain medications.

Older people are often more vulnerable to infectious disease, and as environments change, so will ailment patterns and incidence. Further, the changing climate and environment is rising prevalence of non-communicable diseases (NCDs) such as diabetes, heart disease, cancer, obesity, sensory-organ disease as well as dementias.

An expected 24 per cent of the global disease burden (healthy life years lost) and 23 per cent of all deaths can be attributed to environmental aspects. Diseases which are greatly influenced by changes to the environment include: diarrhoea (e.g. due to unsafe drinking water and poor sanitation and hygiene); lower respiratory infections (e.g. from indoor/outdoor air pollution); 'other' unintentional injuries (e.g. work place hazards, radiation and industrial accidents); and malaria (e.g. changes inland use and drainage) (WHO, 2007).

Long-term increases in temperature variability may increase the risk of mortality in different subgroups of susceptible older populations.High temperatures can result in changes in air quality with an increase in ground level ozone levels further threatening human health (Menz and Welsh, 2010; McMichael et al., 2012).

2. *Disruption to local food supply*

Disruption to local food production as a result of drought or other climate-induced causes impacts on the cost of food and the availability of fresh supplies. The major concern for older persons living on limited income is their ability to maintain an adequate diet in the face of escalating food supply induced by supply shortages.

3. *Transport*

Transport is important issue for people in old age. It provides an essential link to friends, family and the wider community. It is also provides a lifeline to maintaining independence. A lack of mobility can avert older people from participating in social activities and lead to low morale, depression and aloneness. Difficult driving conditions due to snow and ice would decrease but the number of days when driving is difficult due to rain and storms would increase (DfT, 2004).

4. *Cost of Living*

Cost is a significant factor determining people's ability to travel as often as they wish. Climate change is likely to influence economic output via the availability of commodities essential for economic growth, such as water, food and energy. The climate will become an increasingly important determinant of the cost of goods and services. The Stern Report on the economics of climate change concluded that the cost of extreme weather (e.g. as storms, floods, droughts, and heat waves) could reach 0.5 – 1per cent of world gross domestic product by the middle of the century, and will keep rising as the planet warms (HM Treasury, 2006).This may result in inflation due to the higher prices of fuel, food and raw materials. Inflation is of particular concern to people in retirement, even in a relatively mild form. It reduces purchasing power when living on a fixed income.

Household transport costs may rise as private cars are a significant source of GHG emissions. Preventing climate change will require individuals to drive less often, and for shorter distances. Even without policies to reduce car use, rising oil and energy prices will make driving more expensive.

Coping Capacity

Coping capacity is how adaptable an individual is to dealing with the impact of climate change. This is linked to climate sensitivity. However, the importance placed on certain values may vary with ethnic background (Bajekal et al., 2004). Factors which older people value in later life include:

- Quality of neighbourhood: living in a home and neighbourhood that is safe, pleasant with good access to local amenities (e.g. shops, public transport, green space);
- Social networks and community: having social relationships which offer good help and support; material conditions having enough money to meet basic needs and participate in society;
- Health and well-being: having good health and mobility, retaining independence and control over life, engaging in hobbies and leisure activities(solo), having a positive psychological attitude and accepting conditions which cannot be altered (Gabriel and Bowling, 2004; Bajekal et al, 2004).

Coping capacity will be fashioned and further exacerbated by inequalities, social inequality, disempowerment and access to key important services (ODPM, 2006). Therefore, healthy lifestyles, acquisition of coping skills, strong family and social ties, active interests and, of course, savings and assets, all will assist in ensuring that people's reserves are, and remain, strong in later life (Grundy, 2006).

Reducing Older People's Vulnerability to Climate Change

Appropriate policies are needed to encourage people to reduce their personal contribution to environmental change during their life course, to protect older people from environmental threats, and to mobilize their wealth of knowledge and experience in addressing environmental problems. In order to highlight the issues we need to develop the evidence on which policy makers can formulate appropriate age-friendly mitigation and adaptation policies. Some of the important issues are discussed below.

1. Reducing the environmental footprint of an ageing population: Promoting greener attitudes and behaviors and influencing individual lifestyle choices across the life course are measures that can and should be used to reduce the future and current environmental footprint of older people.
2. Protecting older people from environmental change: There is need of policies that reduce the environmental vulnerability of older people and that focus on each part of the dynamic process that creates vulnerability. These comprise policies that make sure people reach later life with adequate reserves (e.g. coping skills, strong family and social ties and savings and assets), reducing the challenges they face in later life, and providing adequate health and social protection.
3. Mobilizing older people in environmental protection: Seniors' knowledge of the local environment, its vulnerabilities and how the community responds allows them to play a key role in reducing the environmental impact of disasters. In particular, their acquaintance of coping mechanisms can be critical when developing local disaster risk reduction and adaptation strategy. This will require additional funding, recruitment and retention strategies, especially for older people from minority communities and older people who are at risk of social exclusion.
4. Climate change proof homes for older people: There should be continued investment to ensure the highest standards of energy efficiency to reduce fuel bills and CO_2 emissions. In order to reduce CO_2 emissions from the housing sector and tackle fuel poverty, it is essential that the homes of older people are climate change proofed as quickly as possible and that this is done for existing homes as well as new build.

5. Enrich local accessibility: The aim of public policy should be to enhance local access possibilities because of its role in sustaining health and in ensuring that community life can continue in a relatively low risk environment should transport systems and mobility be disrupted by climate change. Every local authority should use the opportunity of 'Local Area Agreements and Multi Area Agreements' to re-focus its activities and budgets specifically towards delivering safer, stronger and healthier communities for older people. A major program of local accessibility enrichment and modal shift is taking into account best practice on walking, cycling, public transport and land use planning. The ability to move around a local home area and to access local shops, post offices and medical facilities is central to maintaining health and social interaction. A highly accessible local system is far better adapted to climate change than a centralized system based on assumptions of car ownership and longer distance travel.
6. Leadership on older people and climate change: Leadership is required to address the challenge of growing old in a changing climate and to ensure a safe, secure, equitable and sustainable future for older people. Central government should establish an 'Older People and Climate Change Group' that brings together older people's organizations, key stakeholders, the voluntary sector, government agencies and academia to develop a national policy frame work that sets out cross sectoral interventions and policies to advance the quality of life of elder people. Environmental volunteerism and civic engagement can play a key role in building local community resilience to address environmental challenges such as climate change. It can provide opportunities for better integration in later life and confer benefits both to the individual and community.
7. Home energy use: A key factor which influences levels of CO_2 emissions in later life is the energy efficiency of homes. The over 50s people spend an increasing proportion of their income on fuel as they get older and spend more time indoors. Many energy conservation measures such as cavity wall, loft, and hot water cylinder insulation, draught proofing, installation of efficient boilers, and fitting heating controls, enable significant reductions in CO_2 emissions as well as improving the quality of homes and reducing energy bills. It is essential that atmospheric GHG concentrations are stabilized at a maximum of 450 parts per million (ppm) of CO_2 equivalent (some would argue that 350 ppm is required) to avoid irreversible and extremely damaging climatic changes. This would require all developed countries to cut emissions by atleast 80 per cent from 1990 levels by 2050. Linking energy efficiency schemes with benefit entitlement provision and integrating schemes can create useful improvements within the existing framework.
8. Healthier and independent lives: An integrated and preventative approach to health and social care for older people will ensure have that can enjoy healthy and active ageing. Local health and social care providers need to work more closely to build on services already provided and ensure people are aware of basic entitlements to help them lead healthy, independent lives. This requires an improvement of health and social care services and easier access to use them.
9. Stronger Communities: Supportive neighbor hoods and a sense of community can provide additional assistance to vulnerable older people. Local authorities can contribute to building social cohesion and community capacity through the Local Strategic Partnership (LSP).
10. Personal Carbon Trading: Personal carbon trading is being considered as a measure to reduce carbon emissions and tackle climate change. Personal carbon trading needs individuals to run their own CO_2 emissions. The concept suggests a national emissions cap would be set and carbon credits would be allocated across the population. A personal carbon allowance would be used to purchase particular goods and services (e.g. electricity, gas or transport fuel). Those who need more carbon than their allocated allowance would need to trade with those using less. Overtime the overall emissions cap (and thus each individual allocation) could be reduced in line with national or international agreements (DEFRA, 2008).

Conclusion

Growing old in the twenty-first century will bring with it the unique challenge of changing weather and climate and the impact this will have on all aspects of life. In order to effectively manage the effects of climate change it will be necessary to confront and integrate social dimensions in climate adaptation planning. Social dynamics will determine the vulnerability to climate related threats and the level of resilience of different social and demographic groups. An understanding of the social factors which contribute to older people's vulnerability and resilience to climate change can strengthen the capacity of government and agencies to prevent and minimize the impact of climate change on this demographic group. There is a need to focus on reducing the vulnerability of older people to climate change by improving their adaptive capacity and resilience. Providing a more evidence-based understanding of the consequences of an ageing population and environmental change can support the formulation of appropriate age-friendly mitigation and adaptation policies that understand the factors that contribute to older people's vulnerability to environmental change and the restrictions that prevent them from developing adaptive capacity.

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Shrimp Waste Meal an Alternative Protein Supplement for Replacing Fish Meal in Poultry Diets

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Abstract

The main hurdle in the development of Poultry Industry is the increasing feed cost. Fish meal is the conventional protein supplement used in the poultry diets. The increasing cost of fish meal has led to the use of alternate feed supplements. Shrimp waste meal (SWM) is one such supplement obtained from the processing of shrimp for human consumption. Experiments were carried out to evaluate the shrimp waste meal. The shrimp waste meal was used in poultry diets by replacing the fish meal at different levels. The shrimp waste meal (SWM) reported to have 94.17, 50.5, 8.2, 15.2, 19.1, and 7.0 percent dry matter, crude protein, ether extract, crude fibre, total ash, nitrogen free extract, respectively. The crude protein content of shrimp waste meal ranged from 20.00 - 53.47% as per the reports of many research findings. The calcium and phosphorous content of the SWM was reported as 6.0, and 1.2%, respectively. The percent lysine and methionine were found as 1.66, and 0.88, respectively. Metabolizable energy content of SWM was reported as 1515 kcal/kg diet. The chitin present in the SWM reported to have anti-microbial and immune enhancing activity. The high chitin and calcium contents, could limit the amount of shrimp waste in mono-gastric diets. Chitin has low digestibility when fed to animals. The concentration of E.coli in the caecum was significantly decreased by dietary supplementation of 100 mg/kg of chito-oligosaccharide. Higher serum total protein content was observed when broilers were supplemented with chito-oligosaccharide at 100 mg/kg level. Replacement of fishmeal upto 50% with shrimp waste meal along with supplementation of synthetic lysine and methionine in broiler diets showed significantly ($p < 0.01$) higher liver, gizzard and heart weights (g). The birds also showed higher live weight gain, hot carcass weight and dressing percentage. Up to 50% replacement of fish meal with shrimp waste meal in broiler diets had no effect on mortality rate.

Key Words : Shrimp Waste meal; Chito-oligosaccharide; Broiler diets.

Introduction

The Poultry Industry has emerged as the fastest growing segment of the livestock sector globally due to a number of favorable reasons. Poultry sector, besides providing direct or indirect employment to people, is also a potential tool for ameliorating poverty for many landless and marginal farmers. In addition to contributing to improved human nutrition and food security by being a leading source of high quality protein, poultry/chicken is of economic, social and cultural significance in small societies (FAO, 2010).

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Indian Poultry Industry ranks 3rd in egg production and 5th in broiler production (USDA, 2013). Poultry Industry has however been confronted with the challenges of high cost and scarcity of feed inputs. Feed costs account for nearly 70-80% of the total costs in poultry production. Fishmeal is the only conventional animal protein source for poultry in the country, and poultry is in competition with human and other livestock for dry fish consumption. As a result, the cost of fishmeal is very high and its inclusion in the diet hardly permits profitable poultry farming. The quality of fishmeal is very much variable and availability is uncertain. Fishmeal is often adulterated with other ingredients such as fish bones, sand, sawdust, etc., which adversely affect its nutritive value. Producers sometimes use insecticides for preservation of fishmeal, which may cause toxicity in poultry. Therefore research efforts had been geared towards the use of locally available feedstuffs such as agro-industrial by-products and farm wastes which are less expensive when compared to conventional feed stuffs so that they can be used as a substitute for conventional sources of protein such as fish meal and soya bean meal.

Shrimp waste meal is one of such unconventional protein source that has the potential of being an alternative source of protein in broiler rations, partially or totally replacing conventional protein sources like fish meal. Shrimp waste meal is the dried and milled waste of the shrimp industry which consists of heads, shells and appendages of shrimp (Ingweye et al., 2008). During shrimp processing, the peeling step generates large amount of solid waste. Continuous production of shrimp waste with-out corresponding technology of utilizing the waste has resulted in waste collection, disposal and pollution problem. Shrimp waste can be potentially channeled as a substitute for fish meal in poultry diets.

Shrimp waste is the concentrated product containing proteins with characters of low cost, moisture, deodorized, high digestibility, easy storage that does not require refrigeration and have long shelf life. Shrimp waste contains high CP content and reasonably good balance of essential amino acids (Ngoan et al., 2000). It is particularly rich in lysine which makes it an ideal supplement for cereals (Fanimo et al., 1996). It is palatable and has a pleasant aroma.

Shrimp waste contains 7.87% of water, 26.89% of crude fiber, 24.03% of crude protein, 5.14% of crude fat, 25.60% of ash, 16.69% of calcium and 930 kcal ME/kg (Mahata et al., 2008). Shrimp waste apart from supplying good quality proteins and vitamins A and D, also contains several dietary minerals such as Ca, Fe etc.

Shrimp meal (SM) can be used as a protein source in poultry diets (Fanimo et al., 1996; Rosenfeld et al., 1997; Gernat, 2001; Oduguwa et al., 2004; Khempaka et al.,2006a) or as a source of prebiotic (Khempaka et al., 2011, Zhou et al., 2009) with varying results.

The potentials of shrimp waste meal (SWM) as an alternative protein source in monogastric feeding is not in doubt (Talabi, 1988; Fox et al., 1994). However, the extent of its usefulness and levels of utilization by monogastric livestock is yet to be resolved. To date limited works are carried out in this aspect with variable results.

The present article will review the research work carried by various research workers regarding performance of broilers fed diets containing shrimp waste meal at various levels in terms of body weight gain, feed intake, feed efficiency, digestibility of nutrients, E.coli and Salmonella count of the cecal contents, serological parameters, hematological parameters and carcass traits.

Chemical Composition of Shrimp Waste Meal

Shrimp waste meal is a byproduct from shrimp processing industry and has a high nutritive value (Ngo and le, 2003). Shrimp waste is essentially composed of heads, shells, appendages and tails (Fanimo et al., 2000). The shrimp processing industry has been rapidly growing with significant increase in cultured shrimp production in the South-East Asian region. During shrimp processing the peeling step generates large amount of solid waste, because head and peel represent 40% of the shrimp weight (Gildberg and Stenberg, 2001). The shrimp processing waste generated in India is around 1.25 to 1.50 lakh tons per annum. The major components of the shrimp waste (DM basis) are protein (35-50%), chitin (15-25%), minerals (10-15%) and carotenoids (Ramyadevi et al., 2012).

Shrimp waste is an excellent source of protein (50-60% on DMB), very low in fat and calories. Shrimp waste apart from supplying good quality protein and vit. A & D, it also contains several dietary minerals such as Ca, Fe etc., which are beneficial to animals (Ravichandran et al., 2009). SWM is particularly rich in lysine, which makes it an ideal supplement for cereals (Fanimo et al., 1996).

The chemical composition of shrimp waste meal as reported by various authors is presented in Table

1. CP value of SWM ranged from 20% (Okonkwo et al., 2012) to 50.89% (Rosenfeld et al., 1997), whereas Total ash ranged from 15.64% (Rosenfeld et al., 1997) to 26.73% (Khempaka et al., 2006a), crude fibre ranged from 3.6% (Fanimo et al., 1998) to 29.75% (Khempaka et al., 2006a) and crude fat from 0.94% (Khempaka et al., 2006a) to 10.28% (Khempaka et al., 2011). This variation among studies may be due to the difference in shrimp species (Ngoan et al., 2000; Heu et al., 2003), source of shrimp waste meal (head/shell) (Meyers, 1986) and/or processing method, as these can affect the nutritional values of SWM.

According to NRC (1994) the calcium content of the shrimp waste is 16-50 times more calcium than in fish meal. Mahata et al.,(2008) found the calcium in shrimp waste hydrolysate as 16.35% and phosphorous as 0.83%.The calcium and phosphorous have an antagonistic relationship in the process of absorption in small intestine of the broilers. The high calcium content in broiler diet will reduce the absorption of phosphorous and high phosphorous in diet will lower the absorption of calcium. The calcium and phosphorous deposition will determine the formation of hydroxyapatite for bone compactness during the mineralization process.

Bronner (1987) stated that the contents of the poultry intestine is almost acidic than alkaline. Kheiri and Rahmani (2006) found that Ca might increase the intestinal pH and consequently affect the digestion and absorption of nutrients. High levels of Ca in diet changes the intestinal pH of broiler from acidic to alkaline; this is a possible cause of lower protein digestion and absorption. Scott et al. (1982) also stated that protein plays an important role for broiler growth and protein deficiency will decrease weight gain.

Table 1: Chemical composition (%) of shrimp waste meal as reported by different authors

CP	EE	TA	CF	Ca	P	ME (kcal/kg)	Reference
20.00	7.44	24.50	8.46	NA	NA	NA	Okonkwo et al., 2012
31.58	9.49	19.67	19.82	NA	NA	4023 (GE)	Septinova et al., 2012
36.69	10.28	21.77	19.49	4.92	1.20	1515	Khempaka et al., 2011
48.30	5.75	NA	12.90	3.50	1.00	1870	Aktar et al., 2011
32.50	9.80	26.60	8.70	NA	NA	NA	Ravichandran et al.,2009
24.03	5.14	25.60	26.89	16.69	0.85	938	Mahata et al., 2008
48.30	6.30	17.55	13.30	NA	NA	NA	Ingweye et al., 2008
39.32	0.94	26.73	29.75	6.05	0.97	1,350	Khempaka et al., 2006a
53.47	3.42	16.80	1.18	0.74	0.31	1312	Ojewola and Annah, 2006
40.20	4.80	16.20	10.90	NA	NA	NA	Oduguwa et al., 2004
46.30	9.04	17.04	4.30	7.00	3.03	2500	Fanimo and Oduguwa, 1999
43.71	8.64	17.04	3.60	10.21	0.48	NA	Fanimo et al., 1998
50.89	6.31	15.64	8.92	5.21	1.47	2397	Rosenfeld et al., 1997

Properly collected, preserved and processed good quality SWM with reduced amount of bacterial activity is essential, which otherwise can produce a dicarboxylic reaction turning amino acids from animal protein into biogenic amines, resulting in a toxic effect with the possibility of reducing performance and livability in birds (Dale,1994).

The exo-skeleton of the shrimp is mainly composed of chitin. Subasinghe,(1999) reported that the head, shell and hull of shrimp waste products contained 11, 27 and 24% chitin, respectively. Chitin is a linear polymer of N-acetyl-D-glucosamine unit linked with β (1, 4) glycosidic bonds (Minoru et al., 2002) and chitinase is the enzyme that catalyzes the hydrolysis of chitin to its simple monomer of N-acetyl-D-glucosamine (Park et al., 1997). Chitin physically blocks the access of digestive enzyme to protein and lipid, thus affecting the utilization of these nutrients (Castro et al., 1989). About 10% of the crude protein in whole shrimp meal originates from chitin while up to 50% of the nitrogen in scale meal, originates from chitin (Gohl, 1975).

The major concern with the use of shrimp waste meal is its chitin content which is considered to have low digestibility when fed to animal (Austin et al., 1981). Some species of birds produce chitinase in the proventriculus. In case of the chicken, amounts of chitinase produced are low (Jeuniaux and Cornelius, 1978). Even in species that produce useful levels of chitinase the energy value of chitin is very low, due to poor absorption (Jeuniaux and Cornelius, 1978; Karasov, 1990). Low levels of chitin (0.5%) in broiler diets may improve growth performance.

Fanimo et al. (2000) assessed protein quality of SWM in a balance experiment with rats and results indicated that SWM is inferior to that of fish meal but that supplemental methionine and lysine in SWM diets improved the quality of protein. Ngoan et al. (2000) indicated that the amino acid composition of shrimp waste was fairly balanced, but the low methionine content can limit its value for mono-gastric animals. Other factors such as high chitin and calcium contents, could limit the amount of shrimp waste in mono- gastric diets. Chitin has low digestibility when fed to animals.

Chen et al. (2002) reported that degradation of chitin in SWM may give rise to physiological effects including anti-microbial and immune enhancing activity. Chitin digestibility in broilers has reported to be as low as about 20% (Khempaka et al., 2006 b), although chitinolytic activity occurred in mucosa of the proventriculus in broilers (Koh and Iwamae, 2013).

Mustanur and Katsuki, (2014) reported that in Comparison with hulls, shrimp heads were significantly rich in crude protein (CP) and ether extract (EE) and poor in crude fibre (CF), Total ash (TA) and chitin. Overall, in vitro dry matter (DM) and CP digestibilities were significantly greater in heads than in hulls, which is reasonable because the level of chitin, non-digestible amino polysaccharides, were greater in hulls than heads in all species. Consequently, heads are considered to be more preferable than hulls as a source to generate a good nutritional quality SWM.

Mounica et al., (2019a) evaluated the shrimp waste meal (SWM) and reported percent dry matter, crude protein, ether extract, crude fibre, total ash, nitrogen free extract as 94.17, 50.5, 8.2, 15.2, 19.1, and 7.0, respectively. The calcium and phosphorous content of the SWM was reported as 6.0, and 1.2%, respectively. The percent lysine and methionine were found as 1.66, and 0.88, respectively. Metabolizable energy content of SWM was reported as 1515 kcal/kg diet.

In Vivo Impact of Shrimp Waste Meal on Broiler Performance

Effect of supplementation of shrimp waste meal on body weight gain

Damron et al. (1964) and Raab et al. (1971) incorporated shrimp waste meal at 9.1 and 6.8% in broiler diets and found no statistical difference in performance. Ilian et al. (1985) used shrimp meal, at levels above 10% and found no negative effect regarding broiler productive variables. Islam et al. (1994) reported that chickens receiving the diets containing 14.3% shrimp meal did not show negative effects on body weight gain.

Fanimo et al. (1996) reported non-significant differences regarding body weight gain of broilers both at starter and finisher phase among treatment groups where fish meal contribution to dietary CP of broiler diets was replaced with SWM at 33% level, however significant reduction of body weight gain was noticed at 66 and 100 % level of replacement. Fanimo et al. (1996) suggested that supplementation of shrimp waste meal diets with synthetic methionine and lysine improve the utilization of shrimp waste protein, because the protein quality of shrimp waste meal is inferior to that of fish meal.

Razdan et al., (1997) observed that decreased feed intake and body weight gain when broiler chicks fed with high dietary chitosan (30g/kg) concentration in diets might be induced by the high viscosity and slow motility of the chitosan in the gastrointestinal lumen, stimulating the satiety centre of the brain. Arellano et al. (1997) carried out studies with shrimp meal, by including it in broiler rations at 3, 6 and 9% and found no statistical differences ($P>0.01$) in weight gain per bird.

Okoye et al. (2005) concluded that dietary treatments (0%, 10%, 20% and 30% SWM) had significant effect ($P<0.05$) on body weight gain at the starter phase but not at finisher phase. At the starter phase birds fed 0 % and 10 % SWM diets had statistically comparable weight gain while those fed 20 %, 30 % SWM diets had depressed weight gain at starter phase. At finisher phase, all diets were comparable regarding body weight gain. The decline in performance of birds fed 20 and 30% SWM diets was observed especially at the starter phase. Increased inclusion level of SWM in broiler diets leads to an increase in the total chitin content in the diet resulting in low digestibility of nutrients and absorption in the gastro intestinal tract of broilers. The comparable performance observed at the finisher phase could be as a result of maturity and or age. This is because, as the birds increase in age the gastro intestinal tract and absorption capacity become more efficient in carrying out digestive processes. An indication that older birds were better able to take up chitin than the younger birds.

Ojewola and Annah, (2006) reported that non-significant differences ($P>0.05$) were noticed regarding body weight gain among different dietary treatments with 6 % Danish fish meal, 6 % Cray fish dust meal, 6 % shrimp waste meal, 3% Cray fish dust meal+3% shrimp waste meal, 3 % Danish fish meal + 3 % Cray fish dust meal, 3 % Danish fish meal+ 3 % shrimp waste meal.

Khempaka et al. (2006a) conducted feeding trials with broilers by incorporating SWM at 0%, 4%, 8%, 12% and 16%. There was no significant difference in body weight gains up to 8% inclusion of SWM, but there was significant decrease in body weight gain at 12% and 16% inclusion of SWM in comparison with control and 4% inclusion of SWM. They concluded that decreased body weight gain might have resulted from decreased feed intake and DM digestibility. The SWM used in the study was rich in fiber, ash and poor in CP. It is rich in chitin which might have decreased digestibility and high levels of chitin and or calcium in SWM are possible factors involved in decreased performance.

Ingweye et al. (2008) stated that no significant difference was observed regarding body weight gain in broilers in control (FM replaced with 0% Fish waste meal-FWM) and 25% FWM replaced with SWM but 100% replacement level had least weight gain which did not differ significantly with 50% and 75% replacement levels. The initial slow growth rate with increase in the quantity of SWM in the diet could be inability of birds to handle effectively the highly chitinous diets at tender age.

Mahata et al. (2008) reported that statistical analysis showed significant difference among dietary treatments (0, 4, 8 and 12% SWH) regarding the effects of shrimp waste hydrolysate towards weight gain. Beyond 8% level i.e. birds given diets containing 12% SWH had significantly decreased body weight gain when compared to birds fed other diets.

Iyamu and Uwagboe (2009) conducted a growth trial in broilers. He incorporated shrimp meal at 0, 25, 50, 75 and 100% levels by replacing fish meal and concluded that there was no significant difference between treatments mean for average weight gain. He suggested that shrimp waste meal could replace fish meal protein in diets of broilers.

Khempaka et al. (2011) concluded that inclusion of shrimp waste meal up to 15% did not result in any negative effect on body weight gain. Interestingly the addition of 5% SWM resulted in greater difference in body weight gain when compared to those birds fed control diet, but no significant difference (P>0.05) was observed between these two groups fed with 5% and 15% inclusion of SWM.

Aktar et al. (2011) reported that final live weight was highest in diet 4 (Control fish meal -FM diet replaced with 6 % meat waste-MW and 6% shrimp waste-SW), Intermediate in diet 2 (Control FM diet replaced with 12% MW) and diet 3 (Control FM diet replaced with 12 % SW) and lowest in diet 1 (control diet with 12 % FM).

Okonkwo et al. (2012) reported that there were no significant differences regarding body weight gain among treatment means even though the values showed a normal variation, and the values were 290.42 (T1-0% SWM), 328.34 (T2-5% SWM), 274.96 (T3-10% SWM) and 303.75 (T4-15% SWM) when birds are fed with diets containing SWM.

Effect of supplementation of shrimp waste meal on feed intake

Fanimo et al., (1996) reported that non-significant differences were observed regarding feed intake among treatment groups where fish meal contribution to dietary CP of broiler diets was replaced with SWM at 0, 33, 66 and 100 % of graded levels. Arellano et al. (1997) found that inclusion of shrimp meal at 3, 6, 9% levels in diets of broilers produced non-significant effects on feed consumption.

Gernat, (2001) reported a significant (P<0.01) increase in feed consumption with both 40 and 80% SWM compared to the 0% treatment. Experimental diets include - five different levels of SWM in the diet replacing 0, 20, 40, 60, or 80% of the SBM. These results might be attributed to the high levels of chitin found in SWM. Because chitin reduces dietary energy, the layers fed diets with higher levels of SWM increased feed consumption to maintain their energy needs.

Oduguwa et al. (2004) concluded that feed consumption values at the starter and finisher phases revealed that birds fed the control diet (FM/SBM) consumed more than those on the other diets (SBM/SWM and FM/SWM) and the difference in the values between treatment groups (diet 2 and diet 3) were non-significant (P>0.05).

Hector and Lourdes, (2005) reported non-significant differences regarding feed intake among treatments groups (3%, 6% and 9% SWM). Okoye et al., (2005) concluded that dietary treatments (0%, 10%, 20% and 30% SWM) had significant effect on feed intake. At starter phase significantly highest feed intake was noticed in birds fed control diet and significantly lowest in birds fed diet with 30 % SWM. At finisher phase, feed intake was found to be significantly highest in birds fed diet containing 20 % SWM.

Khempaka et al. (2006a) concluded that there was no significant difference in feed intake up to 8 % inclusion of SWM, but there was significant decrease in feed intake at 12 % and 16 % inclusion of SWM in comparison with control and 4 % inclusion of SWM. With increase in SWM in the diet, Ca level in diet was increased. It was reported that high levels (1.3-1.5 %) of calcium decreased feed intake in chickens (Smith and Taylor, 1961, Watkins et al., 1989), in addition high levels of sodium in SWM has been reported to decrease feed intake (Damron and Kelly, 1987; Balog and Millar, 1989)

Ingweye et al. (2008) stated that no significant difference was observed regarding feed intake among dietary treatment groups. Replacement of fish meal with shrimp waste meal at 0 (T_1), 25 (T_2), 50 (T_3), 75 (T_4) and 100 % levels (T_5) showed that the feed intake ranged from 296.15±36.55 to 328.85±41.21 g/bird, 947.49 ±76.98 to 1048.13±69.79 g/bird and 621.82±71.33 to 688.49±57.08 g/bird for the starter, finisher and combined phases, respectively.

Mahata et al. (2008) reported that statistical analysis showed non-significant difference with regard to feed consumption among treatment groups (0, 4, 8 and 12%). Iyamu and Uwagboe (2009) carried out studies in broilers where shrimp meal was incorporated at 0, 25, 50, 75, and 100% of graded levels by replacing fish meal in the experimental diets. No statistical difference was found ($P>0.05$) regarding feed consumption among treatment groups.

Aktar et al. (2011) reported that feed consumption of broilers at 28 days of age was similar in all experimental diets ($P>0.05$). At 42, 56 days of age highest feed intake was observed in broilers receiving diet 1 (control diet with 12 % Fish meal) and lowest on diet 4 (Fish meal of the control diet replaced with 6% Meat waste and 6% Shrimp waste) and intermediate in diet 2 (Fish meal of the control diet replaced with 12 % Meat waste) and diet 3 (Fish meal of the control diet replaced with 12 % Shrimp waste).

Khempaka et al. (2011) reported non-significant differences with regard to feed intake among treatment groups (control, 5%, 10%, 15%, 20 % Shrimp waste meal diets). Okonkwo et al. (2012) showed that non-significant differences were observed regarding feed intake among treatment means in spite of the variation in values and the feed intake (g) was 1614.57 (T_1-0% SWM), 1549.00 (T_2-5% SWM), 1525.71 (T_3-10% SWM) and 1541.29 (T_4-15% SWM).

Effect of supplementation of shrimp waste meal on feed conversion ratio (FCR)

Fanimo et al. (1996) reported non-significant differences with regard to FCR of broilers at finisher phase among treatment groups where fish meal contribution to dietary CP of broiler diets was replaced with SWM at 33% and 66% level, however significant difference (poor efficiency) was noticed at 100% level of replacement.

Arellano et al. (1997) conducted a feeding trial in broilers and he reported that the feed efficiency was poorer for the diets containing shrimp meal at 40% and 80% level. The feed efficiency was poorer because of the increase in feed consumption in those dietary treatments.

Experimental reports of Oduguwa et al., (2004) revealed that birds fed with control diet (FM/SB) had best FCR than diet 2 (SBM/SWM) and least with diet 3 (FM/SWM) both during starter and finisher phases. Hector and Lourdes, (2005) reported that FCR was similar for all treatments (control, 3%, 6% and 9% SWM) at starter phase however at finisher phase birds fed control diet (2.44) and birds fed 3% SWM (2.71) had significantly lower FCR than those fed 9% SWM (4.50), while FCR of birds fed 6% SWM was comparable with other treatments (control, 3% and 9 %).

Okoye et al., (2005) concluded that dietary treatments at 0%, 10%, 20% and 30% SWM had significant effect on feed to gain ratio at the starter phase but not at finisher phase. At the starter phase birds fed with 0% and 10% SWM diets had statistically comparable feed to gain ratio while those fed 20%, 30% SWM diets had significantly ($P<0.05$) higher feed to gain ratio. At finisher phase, all diets were comparable regarding feed to gain ratio.

Ojewola and Annah, (2006) reported non-significant differences ($P>0.05$) regarding feed conversion ratio among different dietary treatments (6% Danish fish meal; 6% cray fish dust meal; 6% shrimp waste meal; 3% Cray fish dust meal + 3% shrimp waste meal; 3% Danish fish meal + 3% Cray fish dust meal; 3% Danish fish meal + 3% Shrimp waste meal).

Khempaka et al., (2006a) concluded that there was no significant difference in feed efficiency up to 8% inclusion of SWM, but there was significant ($P<0.05$) decrease in feed efficiency at 12% and 16% inclusion of SWM in comparison with control and 4 % inclusion of SWM.

Ingweye et al. (2008) reported that FCR was best at 0% level of replacement and higher values were recorded for 100% replacement level which did not differ significantly (P>0.05) with 50 and 75% replacement level and thus concluded that 25% level of replacement of FWM with SWM was optimum for broiler performance. The feed conversion ratios were best (P<0.05) at the 0% replacement level for all the phases i.e., 1.45±0.12, 1.90±0.13 and 1.67±0.12 for the starter, finisher and combined phases respectively. These were not different (P>0.05) from the control in all the phases. The worst values (P<0.05) were 3.50±0.22, 3.42±0.25 and 3.46±0.31 recorded for the starter, finisher and combined phases respectively, at 100% replacement level. Feed conversion ratio was inversely related to the feed intake. As the level of shrimp waste in the diet increased, feed conversion ratio increased. This could be as a reflection of increasing feed intake and decreasing weight gain.

Mahata et al. (2008) reported that the statistical analysis showed significant difference among dietary treatments (0, 4, 8 and 12% Shrimp waste hydrolysate) regarding FCR. The FCR beyond 8% level of inclusion i.e birds fed diet with 12 % SWH had significantly higher FCR when compared to birds fed other experimental diets. Khempaka et al. (2011) reported that FCR did not change significantly when SWM was at or below 15%. Interestingly the addition of 5% SWM resulted in greater difference in FCR (1.88) when compared to those birds fed control diet (1.95), but no significant difference (P>0.05) was observed between these two groups (control and 5% SWM).

Iyamu and Uwagboe (2009) reported that there was no statistical difference (P>0.05) among dietary treatments (0, 25, 50, 75, 100%) regarding FCR. Aktar et al. (2011) reported that feed conversion of broilers at 28 days of age did not differ significantly (P>0.05) among experimental diets. But at 56 days of age highest feed conversion was observed with diet 4 (FM of Control diet replaced with 6% MW and 6% SW) and lowest with diet 1 (control diet with 12% FM) (P<0.01).

Okonkwo et al. (2012) showed that feed conversion ratio did not differ significantly among dietary treatments (T_1-0% SWM), (T_2-5% SWM), (T_3-10% SWM) and (T_4-15% SWM) but numerically lower values were observed in SWM supplemented groups when compared to control.

Effect of supplementation of shrimp waste meal on nutrient digestibility

Gohl, 1975 reported that about 10% of the crude protein in whole shrimp meal originates from chitin while up to 50% of the nitrogen in scale meal originates from chitin which is nearly indigestible.

The enhanced ileal digestibility of nutrients in the broilers fed chitin oligosaccharide containing diets might be due to reduced number of pathogenic bacteria like Escherichia coli, Salmonella typhimurium (Choi et al., 1994; LeMieux et al., 2003; Wang et al., 2003., Boyle et al., 2007; McNulty et al., 2007) and increase in the number of the beneficial bacteria like Lactobacilli (Oli et al., 1998) in the intestine. Such changes in the intestinal bacterial population resulted in a decrease in the incidence of diarrhoea (Oli et al., 1998) and increase in immune function (Gibson and Roberfroid, 1995; Patterson and Burkholder, 2003).

The chito-oligosaccharides may stimulate the secretion of digestive enzymes from the stomach, pancreas and intestinal mucosa (Hou and Gao, 2001). This effect is expected to reduce local inflammation in the intestinal mucosa, facilitate the breakdown of complex molecules into simpler ones and enhance the integrity of enterocytes, thereby promoting the digestion and absorption of nutrients (Wu, 1998). Through an increase in the digestion and absorption of nutrients, dietary supplementation with COS reduces the excretion of fecal nitrogen and phosphorus from animals, thereby minimizing the major sources of environmental pollution.

Dietary supplementation of 100 mg/kg of COS to broilers was as effective as well-documented antibiotics (6 mg/kg of flavomycin) in enhancing the ileal digestibility of nutrients and average daily gain, compared with the broilers fed the basal diet. Thus, compared with feeding an antibiotic, dietary COS supplementation to poultry and other livestock species offers three unique advantages: 1) preventing drug resistance in animals and humans; 2) improving the health of the small intestine; and 3) increasing the ileal digestibility of dietary phosphorus (Huang et al., 2005). Chitin physically blocks the access of digestive enzymes to lipids and protein thus effecting the utilization of these nutrients (Castro et al., 1989, Karasov, 1990).

Hector and Lourdes, (2005) reported that body weights of broilers decreased significantly as percentage of shrimp meal increased beyond 6 % in the diet. Khempaka et al. (2006a) concluded that there were no significant differences regarding DM digestibility and nitrogen retention up to 8 % inclusion of SWM, but there was significant reduction at 12% and 16% inclusion of SWM in comparison with control and 4% inclusion of SWM.

Ojewola and Annah, (2006) reported that non-significant differences were observed regarding fat, ash, crude fiber digestibility and nitrogen retention among treatment groups (6% Danish fish meal; 6% Cray fish dust meal; 6% shrimp waste meal; 3% Cray fish dust meal + 3% Shrimp waste meal; 3% Danish fish meal + 3% Cray fish dust meal; 3% Danish fish meal + 3% Shrimp waste meal).

Mahata et al. (2008) reported that statistical analysis showed significant difference among dietary treatments regarding effects of shrimp waste hydrolysate toward nitrogen retention beyond 8% level of inclusion i.e birds fed diet with 12% SWH had significantly lower nitrogen retention values when compared to birds fed other diets. Khempaka et al. (2011) reported that DM, OM and Ash digestibility values and nitrogen retention did not change significantly when SWM was at or below 15%.

Khambualai et al. (2008 and 2009) reported that supplementation of low dietary chitosan (0.6g/kg) concentration until 7 weeks of age in marshal chunky broiler chicks had increased feed intake and body weight gain due to better absorption of nutrients.

Effect of supplementation of Shrimp waste meal on microbial count

The use of shrimp waste meal as a protein source in poultry diets have a beneficial effect, it can potentially alter the microbial ecology of the intestine. Acidic digestive fluid in the proventriculus and gizzard may degrade the shrimp shell to release chitin. In the neutral pH of the small intestine, chitin would gradually precipitate and move into the large intestine (mainly the caeca), where microbes may release enzymes to hydrolyze chitin.

The degradation products of chitin can inhibit the growth of harmful bacteria (Chen et al., 2002) and enhance the growth of Bacteroides spp. in the ceca of rats (Chen and Chen, 1999). It is well known that the microbial community and its activity play important role in the intestinal, physiological, immunological and protective functions of the poultry intestinal tract and can be influenced by diet composition.

Salmonella spp., pathogenic E. coli, considered to be food borne pathogens and they are commonly found in the gastrointestinal tract of poultry. Izat et al. (1991) reported that poultry products are frequently contaminated with various serotypes of Salmonella and with E. coli strain O157:H7. Salmonellosis in humans is most frequently associated with the consumption of contaminated fresh and processed poultry products (Lynch et al., 2006; Foley et al., 2011). According to Foley et al. (2011) Salmonella Typhimurium continues to be among the most common serovars isolated from poultry and a common cause of human salmonellosis. Furthermore, public concern associated with antibacterial strains is challenging the poultry industry to find alternative means of control and consequently, continuous studies on alternative methods to control food borne pathogens are necessary (Boyle et al., 2007; McNulty et al., 2007 and Menconi et al., 2014). Feeding SWM has shown to enhance the growth of Lactobacillus and to inhibit the growth of E. coli and Salmonella in the intestine.

Khempaka et al. (2006b) reported that approximately 20% of chitin can be digested in the gastrointestinal tract of broilers. Chen et al. (2002) reported that degradation of chitin in SWM may give rise to physiological effects including anti-microbial and immune enhancing activity.

Li et al. (2007) reported that the concentration of E.coli in the caecum was significantly decreased by dietary supplementation of 100 mg/kg of chito-oligosaccharide in comparison with the control birds. Khempaka et al. (2011) reported that feeding broilers with SWM resulted in increased population of lacto bacillus and decreased intestinal Escherichia coli and cecal Salmonella. Menconi et al. (2014) reported that in vivo reduction in cecal Salmonella Typhimurium (ST) may decrease the overall pathogen load in birds, making them less likely to spread the infection further. They reported that the addition of 0.2% chitosan in broiler diet proved to be an effective alternative tool to reduce colonization of ST in broiler chickens and significantly reduced ST counts in crop and cecal content leading to reduced carcass ST contamination as well as decreasing the amount of ST shed to the environment.

Effect of supplementation of shrimp waste meal on serum constituents (Protein, Albumin, Globulin, Cholesterol, Glucose)

Kobayashi and Itoh, (1991) reported that dietary chitosan inhibited the increases in plasma triglyceride concentration and abdominal fat weight in laying type chicks fed high-fat diets.

Olayemi, (2001) reported that non-significant differences were observed regarding serum metabolites among dietary treatments T_1 (soya bean & fish meal), T_2 (FM was replaced with SWM), T_3 (SBM was replaced with SWM). Li et al., (2007) reported that higher serum total protein content was observed when broilers were supplemented with chito-oligosaccharide at 100 mg/kg level than other treatment birds.

Zhou et al. (2009) reported that chito oligosaccharide supplementation had no effect on the total protein in treatment and control groups. Abiodun Adeyeye et al. (2014) reported that the levels of serum cholesterol increased as the level of SWM substitution increased in turkey poults.

Effect of supplementation of shrimp waste meal on hematological parameters

Meng et al. (2010) reported an increase in the concentration of WBC when laying hens were fed chito-oligosaccharides at 0.4 % of diet. Chen et al. (2002) concluded that 5g/kg of chito-oligosaccharides supplementation added in the diet did not affect the concentration of WBC, RBC and lymphocyte.

Zhou et al. (2009) reported that the RBC counts were 18.2% greater in birds fed chito-oligosaccharides at 0.4 % of diet than in birds in the control group. However, chito-oligosaccharide supplementation had no effect on the white blood cells and lymphocytes.

Mounica et al. (2019b) carried out an experiment to assess the effect of feeding Shrimp waste meal as a replacement for fish meal on serological, hematological parameters and carcass traits in broilers. The growth trial was conducted for 42 days using 375 commercial day old chicks which were distributed randomly into five treatments groups with three replicates of twenty five birds each. In pre-starter diet, fish meal contribution to the dietary crude protein was replaced with shrimp waste meal at 0% (T1), 20% (T2), 30% (T3), T2 + synthetic lysine and methionine (T4), T3 + synthetic lysine and methionine (T5). In starter and finisher diets the shrimp waste meal protein was added up to the 0% (T1), 50% (T2), 100% (T3), 50% + synthetic lysine and methionine (T4), 100% + synthetic lysine and methionine (T5). In pre-starter and starter phases no significant differences were noticed regarding levels of serum total protein (g/dl), albumin (g/dl), globulin (g/dl), glucose (mg/dl) and cholesterol (mg/dl) among treatments. Similarly, in finisher phase there were no significant difference in levels of serum total protein (g/dl), albumin (g/dl) and glucose (mg/dl) among treatments, except the serum cholesterol levels (mg/dl) and globulin levels (g/dl) were found significantly ($p < 0.01$) higher in birds fed T1 diet than birds fed other diets (T2, T3, T4 and T5). Non significant differences were noticed among treatment groups regarding RBC count during the three phases of the study.

Effect of supplementation of shrimp waste meal on broiler carcass traits

Fanimo et al. (1998) reported increase in the liver weight and decrease in plucked weight with increase in shrimp waste meal in the diet. However, no significant difference was reported regarding dressing percentage among treatment groups (dietary CP contributed by FM was replaced with SWM at 0, 33, 66 and 100 % graded levels).

Olayemi, (2001) reported non-significant differences regarding gizzard, spleen, kidney and lung weight but heart & liver weight varied significantly among treatment groups (T_1-soya bean & fish meal, T_2-FM was replaced with SWM, T_3-SBM was replaced with SWM). Cunha et al. (2003) reported that no significant differences were observed regarding breast, thigh and drumstick yield of broilers fed 0, 3, 6, 9 and 12 % Shrimp waste meal.

Agunbiade et al. (2004) reported non-significant differences among treatment groups for liver, heart and gizzard weight in broilers fed cassava products diets supplemented with Shrimp waste meal. Hector and Lourdes, (2005) reported that final live body weight and plucked carcass weight were similar for control, 3% and 6% SWM treatments but significantly higher than 9% fed group. Dressed carcass weight of control and 3% SWM fed groups was significantly higher than 6% and 9% SWM diets.

Mahata et al. (2008) reported that statistical analysis showed non-significant differences among dietary treatments (0, 4, 8 and 12% SWH) with regard to carcass percentage. The average percent of digestive organs: liver, proventriculus and gizzard were not significantly affected by shrimp waste supplementation.

Aktar et al. (2011) reported that dressed yield, total meat and drumstick meat were highest ($P<0.01$) on diet 1 (control diet with 12 % FM) and diet 4 (FM of control diet replaced with 6% MW and 6% SW) and intermediate in diet 2 (FM of control diet replaced with 12% MW) and lowest in diet 3 (FM of control diet replaced with 12% SW) and other meat yield characteristics were not influenced by diet ($P>0.05$).

Okonkwo et al. (2012) reported non-significant ($P>0.05$) differences among treatment groups (T_1- 0% SWM, T_2 -5% SWM, T_3-10% SWM and T_4-15% SWM) for plucked weight, dressed weight, eviscerated weight, neck, wing, thigh/drumstick, breast, gizzard, liver and heart weights.

Mounica et al. (2019b) reported that replacement of fishmeal upto 50% with shrimp waste meal along with supplementation of synthetic lysine and methionine in broiler diets showed significantly ($p < 0.01$) higher liver, gizzard and heart weights (g). The birds also showed higher live weight gain, hot carcass weight and dressing percentage.

Effect of supplementation of shrimp waste meal on mortality

Jarquin et al. (1972) found higher mortality in birds fed on diet where shrimp by-product replaced fish meal of control diet. Islam et al. (1994) reported that survivability was similar in control fish meal diet and test diets in which 50% dietary fish meal was replaced with shrimp waste. However, survivability was reduced with diet in which 75% dietary fish meal was replaced by shrimp waste.

Fanimo et al. (1998) reported that mortality increased with level of SWM in the diet at the starter phase. This may be due to the inability of the chicks at this early age to cope up with the chitin level in SWM. Cases of leg problems were observed during the early stage of the birds but they later overcame it. These observed leg problems may be due to the high ash or mineral content (especially Ca:P ratio) of the SWM which may lead to mineral imbalance. Calcium carbonate is responsible for the scleratization of the exoskeleton and represents most of the mineral matter. Because of its high mineral level, SWM is usually used in combination with other protein supplements (Meyer and Rutledge, 1971).

Gernat, (2001) reported non-significant differences among treatment groups with regard to mortality. Mortalities for all treatments (five different levels of SM in the diet replacing 0, 20, 40, 60, or 80% of the SBM) were less than 1%. Aktar et al. (2011) reported that survivability was not affected by different dietary treatments (control diet with 12% Fish meal, FM of control diet replaced with 12% meat waste, FM of control diet replaced with 12% Shrimp waste, FM of control diet replaced with 6% meat waste and 6% shrimp waste).

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Review Article

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Impacts of Seasonal Variation on Livestock Productivity and its Abatement Strategies

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Abstract

India has largest livestock population in the world. India is fortunate as the huge heterogeneous livestock population, which includes cattle, buffalo, seep, goat, pig, mithun, yak, horse, pony, mule, donkey, camel, dog, rabbit, elephant and poultry. Such world's largest livestock population is the back bone of Indian economy and basis of daily livelihood of rural population. Productivity through such huge livestock population and efficient sustainability of livestock owners depends upon highly influential seasonal variables i.e. winter, spring, summer and monsoon persist in the country. Thus, above article assigned to elaborate various manage mental strategies to minimize the influences of environmental variable and year round sustainable productivity through livestock.

Key words: Livestock; Season; Productivity.

Introduction

India is agriculture dominated country. Agriculture and its allied sectors are among the major contributor in Indian economy (around 14% contribution), which generates jobs opportunities for around 50% population of country. Such vital agriculture sector critically depends upon livestock productivity as livestock rearing provides direct day to day income and sustainability for livestock owners. India has 536 million livestock population (DAHDF, 2019). The total livestock population showed 4.6%increasing trend, as compared with DAHDF, 2012 livestock census (DAHDF, 2019). Indian total bovine population (i.e. cattle, buffalo, mithun, yak around 302.79 million) showed 1% increasing trend over the last census (DAHDF, 2019). Among the bovine population, cattle showed highly variable trend i.e. 0.8% increasing trend, female cattle showed 18.0% increasing trend over last census, indigenous/ non- descript cattle population showed 10.0% influential trend over the last census (DAHDF, 2019). However, total indigenous/ non-descript cattle population showed 6.0% declining trend over the last census (DAHDF, 2019). Total exotic/ crossbred cattle showed 26.9% increasing trend over the last census (DAHDF, 2019). Total buffaloes population (109.85 million) showed positive growth rate of 1.0%, as compared with last census (DAHDF, 2019). Total milch population of cattle and buffalo (125.34) showed positive growth rate of 6.0% (DAHDF, 2019). Total small ruminant

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livestock i.e. sheep (74.26 million) and goat (148.88 million) showed positive growth rate of 14.1% and 10.1%, respectively (DAHDF, 2019). Total pig population (9.06million) declined by 12.03% over the previous census (DAHDF, 2019). Total poultry population (851.81 million) influenced by 16.8% over the last census (DAHDF, 2019). However, total backyard poultry (317.07 million) and total commercial poultry (534.74 million) enhanced by 46% and 4.5%, respectively, over the last census (DAHDF, 2019). Survivability, adoptability and profitability through such world's largest livestock population directly influences of marked seasonal variations. Fifteen agro-climatic zones persist throughout the country; those are highly influential for various aspects of livestock rearing. Four contrasting types of climate i.e. winter (persist during December to January), spring (February to march), summer (April to June), monsoon (July to mid September) also highly influential for animal Survivability, adoptability and profitability.

Thus aforesaid article has been designed for critical scientific seasonal management of livestock to influence the productivity through livestock rearing and harvest more and more profitability through livestock sector.

Winter Management of Livestock

Winter, especially extreme cold (December to January) drastically affects the survivability and adoptability of livestock. A higher mortality and disease incidence, especially during calf hood stage is more common in winter season. Extreme cold is challenging condition for survival. Thus, various manage mental aspects such as, farm orientation (Design in East- West direction to get rid of excessive exposure of west direction cold wind), shed design (Proper covering of all air entrance except few ventilators to get rid of excessive ammonia accumulation), floor bedding materiali.e. dry roughage such as "Puaal" (Fig: 1), heating source (such as bulbs, heaters etc) should be sufficiently available to decline the possible chances of pneumonia,congestion, hypothermia or other respiratory ailments, clean moderate warm drinking water, artificial or natural sun light exposure (if available during afternoon hours), shifting of grazing in day time and avoidance during early morning and evening hours, jute beg wear for livestock to minimize cold stress.

Some long day breeder species such as ovine, caprine and equine are long day breeder and requires longer day length and light intensity.

Fig. 1 Small ruminants shed management to minimize cold stress. (Source: ILFC-II Unit, SVPUAT- Meerut)

Thus, artificial lightening or melatonin implants helps to sustain the reproduction efficiency of such species. Nutritional management is quiet efficient in winter season as lot of green fodder (Rabi crops) are available to justify nutritional requirement of livestock. Various Rabi season green fodder such as berseem, jai, oat etc. are available to fullfill the daily maintenance requirement of livestock. Ad lib availability of such green fodder is sufficient for maintenance requirement as well as the production requirement of low yielding livestock. Excess availability of such Rabi crops in winter season is able to minimize the feeding cost of livestock. Proper proportion of green leguminous Rabi fodders and dry roughage (2/3rd and 1/3, respectively) can full fill the daily need of livestock. Nutrition, especially concentrate feeding is most expensive investment in livestock rearing and livestock owners have to invest 65-70% cost of rearing in nutrition alone. Thus, minimizing the cost of feeding through adlib green leguminous fodder, kitchen left over and dry fodder will surely influence the profit margin to livestock owners. Spare green fodder during winter season can be conserved as hay, haylage, silage to feed the livestock during lean period of fodder availability. Hay, silage manufacturing process is commonly used in commercial dairy farm to insure year round availability of green fodder.

Summer Management of Livestock

Likewise winter livestock management, summer management is also tough task to sustain the productivity through livestock. Heat stress during summer declines the productivity and fertility of livestock. Poor fertility, scarcity of green fodder etc factors during summer season creates lot of hindrance to rear livestock. Thus, various manage mental factors such as, availability of open area (with facility of natural of artificial shed) and covered area with sufficient windows and ventilators. Whole time availability of good quality clean drinking water should be available. Nutritional resources are scarce during summer season as less availability of green fodder crops and seasonal grasses. Thus, hay, silage feeding practices are prolific during summer season. Processing of green and dry roughage (cutting, soaking, grinding etc) enhance the nutritional value of available feed resources. Early morning or late night grazing should practice during summer season. Large ruminants, especially buffaloes are very prone for summer heat stress. Thus, pond, fountain, sprinklers should provide to lesser the effect of heat stress.

Rainy Season Management of Livestock

Lot of green grasses and other feeding ingredients are available for livestock feeding during rainy season but side by side chances of infectious diseases, compromised hygiene enhances during rainy season. Thus, proper covered area, routine cleaning practices should be implementing. Water logging conditions in covered as well as open areas of shed are big issues during rainy seasons. Thus, proper drainage of floor should be available around the vicinity of farm. Maintenance feeding requirement cane be full fill through available grasses and feeding cost may be minimized. Pre monsoon vaccination should strictly follow to minimize the occurrences of various infectious diseases such as foot and mouth disease, haemorrhagic septicaemia etc.

Spring Season Management of Livestock

Overall manage mental, climatic conditions are favourable during spring season. Thus, extra care minimized during such season. Manage mental aspects are favourable, optimum temperature for survival of livestock is available, chances of infectious diseases are less, sufficient availability of fee resource. Thus, free range grazing (Fig:2) should offer to the livestock.

Fig. 2 Free range feeding facility to enhance livestock's productivity and sustainability

(Source: ILFC-II Unit, SVPUAT- Meerut)

Conclusion

Seasonal variation directly or indirectly affects the well being of livestock. Changing environmental conditions such as temperature, relative humidity, disease incidences are quiet differ in various season and livestock response accordingly. Thus, modulations of season wise manage mental, nutritional and clinical approaches surely enhance the productivity, sustainability and well being of livestock.

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2. ILFC II (2020). Instructional Livestock Farm Complex, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram-Meerut.

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Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

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Article in supplement or special issue

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Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

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[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

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Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18.

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