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A Review

Economic Importance of *Lentinulas edodes* as an Alternative to Antibiotics Growth Promoters to Small Scale Rural Pig Farmers of Limpopo Province, South Africa: A Review

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The main objectives of this paper were to highlight the relevant literature on the processes and nutritional challenges of pig farming in the Limpopo Province, South Africa. The goal was to investigate and highlight the edible mushroom specie- *Lentinulas edodes*- as cheaper, richer and more readily available alternative feed additives that can be used by emerging small scale pig farmers of the Limpopo Province for pig nutrition. The review revealed that the biggest challenge to pig farming in the Limpopo Province is animal malnutrition, which is as a result of poor financing and this makes it impossible for farmers to afford the standard feeds required for the proper nourishment of their livestock. It was also observed that the *Lentinulas edodes,* which is readily available, contains medicinal properties such as immunomodulatory and antioxidants which can help to improve the health of the pigs. Since most of the Limpopo Province small scale pig farmers are unable to afford vaccines and medicines, the *Lentinulas edodes* was recommended as the best alternative to improve their piggery nutritional and health management practices.

Keywords: Small scale pig farmers, Limpopo province, Lentinulas edodes, Malnutrition, Pigs, Poverty and Pharmacology**.**

INTRODUCTION

For over 100 years, most edible mushrooms due to their pharmacological properties have been used as medicine around the world to treat human diseases such as cancer and infertility. This technology has been widely applied in China, India, Japan and Korea (Lull, 2005 ; Ali, 2010). Recently, most of the researches carried out on this subject have discovered that edible mushrooms contain nutritional properties such as carbohydrates (fiber and β-glucans), proteins (amino acids) and vitamins (, B1, B2, B12, niacin, and vitamin C and D (Chang, 2012). The fungus *Lentinulas edodes* (*L. edodes*) which is popularly known as Shiitake mushroom, belongs to the class Basiomycetes. Ussually, these fungusare found to grow on decaying deciduous trees such as oaks, cotton wood and humid climate.According to the literature by Hawksworth, (2001); Ely et al., (2014) , the fungus *L. edodes* are the world's second largest cultivated fungi.

The *L. edodes* were reported to contains dietary fiber in a form of soluble and non-soluble carbohydrates and are also ideal for diabetics which can improve the digestion of feeds in the stomach, absorption of nutrients by the small intestines and fermentation of undigested feeds in the hind gut of non-ruminants (Chang et al.,

2012 ; Lee et al., 2014).This was further reported by Ferreira, (2010) ; Xu et al., (2012) after the observed that medicinal properties such as immunomodulatory and antitumor properties available in this mushroom. These medicinal properties are capable of treating various gastrointestinal diseases in farm animals such as stomach tumor (which may cause stomach cancer), obesity, and others. The *L. edodes* contains less of sodium and glucose.To be precise, the use of *L. edodes* as a source of selenium to prevent cancer in most parts of Japan, has been due to its carbohydrates structure, lentinan (Alexopolous et al., 2002).

Weaning is one of the most stressful events in pig industry. This is because piglets are born with immature gastrointestinal and there are millions of microfloras with different species within the gut tract. Their roles is to to improve digestion in the stomach and fermentation in the colon (Campbell et al., 2013). Immediately after birth, pigs can survive few hour with the aid of immunoglobulin from the sow's colostrums (Sulabo et al., 2010).

The application of Antibiotic Growth Promoters (AGP) in improving growth performance, feed intakes, carcass quality and treating stomach diseases in pig and poultry nutrition is of the most the significance as was reported by Pavlik et al., (2010). However, due to the overuse of these drugs by farmers it has created a public panic on the human (World Health Organization, 2011). These consequences have led to the ban of using AGP in most part of the world. (Jacela et al., 2010).

Recently in the research study conducted by Van Boeckel et al., (2015), it was suggested that the use of artificial antimicrobials by South African emerging livestock farming farmers, its local markets and global consumption trends in 2010 estimated between 60,000-65,000, respectively. It was demonstrated that it is likely to threaten the increase by 2030 if policies are not changed, this could negatively affect the entire livestock production. According to the department of Agriculture Forestry and Fisheries, pig production in the Limpopo province plays a very crucial role in rural communities by improving human nutrition, helping to fight poverty through job creation and promoting skills development. Currently, Limpopo province takes the lead in pork production with 24% rates followed by Northwest Province (20%); Gauteng Cape Province (11%); Mpumalanga Province (8%); Western Free State province (8%); Eastern Cape Province (6%) and Northern Cape (2%), (SAPPO, 2011).These Provinces are the main pillars of economic strength to South African GDP (Department of Agriculture, Forestry and Fisheries (DAFF 2012).

The continuous increase in costs of pig feeds is a major constrain forcing emerging small scale pig farmers to rely on traditional feeding methods such as feeding pigs with kitchen wastes, etc (Madzimure et al., 2014).

These non nutritious feeding methods encourage the spread of diseases shown in figure 2, particularly diarrhea in pre-post weaned piglets (Wallgren and L. Melin, 2001).It becomes very difficult for the small scale pig farmers to evaluate and estimate the nutritional values of feeds to meet the National Research Council (NRC) requirements. Such consequence may affect the entire performance and leads to poor carcass quality after slaughter (DAFF, 2011).

Recently, new technological strategies have been adopted whereby mushrooms, plants and herbs have been used to overcome all of these problems facing small scale pig farmers in rural communities of developing countries. This is to satisfy or meet consumer's demand by supplying/producing quality leaned meat (Bisen et al., 2010).

The objectives of the current study was to highlight the relevant literature on the processes and nutritional challenges of pig farming in the Limpopo Province, South Africa based on the followings: Small Scale Pig Farming System in Limpopo Province, Economical Significance of Pigs to Small Scale Pig Farmers of Limpopo Province and Significance of *Lentinulas edodes* fungus on improving the nutritional requirements of Pigs against the malnutrition in human. It further seeks to highlight how this could enhance job creation and sundry opportunities for development in rural communities under the emerging small scale pig farming practices in Limpopo Province, while projecting *Lentinulas edodes* as alternative to the banned antibiotics growth promoters which have been used to improve pig growth performance, pork quality and cure for clinical diseases in pig nutrition and production in the past decades.

Small Scale Pig Farming System in Limpopo

The Small scale farming according to Anseeuw et al., (2015), describes the types of practices by the emerging farmers whom were previously disadvantaged and can only get support from the government. They types of farmers are characterized by low income and assets and their operation is usually of less than 2.5 HA of the land for both crops cultivation of crops and livestock rearing. And as such, their family members automatically become the labors of the enterprise (Diao et al., 2010; DAFF, 2010; Meissner et al., 2013).

Challenges facing Small Scale Pig Farmers (SSPF)

The majority of small scale pig farmers in Limpopo province rely on a backyard pig farming system for income to support their families and with little or no support from the government such as a Land

Source: South African Weather Services, 2015

Figure 1: Drought and Water shortage in other parts of the Limpopo Province

Source: Author's research.

Figure 2: Traditional feeding method

Figure 3: Disease outbreaks in backyards

Redistribution for Agricultural Development grants. The province is therefore largely characterized by subsistence pig farming. The biggest challenge facing these farmers is high mortality rate which affects most of the piglets before and after weaning periods (Fasina et al., 2014). According to a research reports by Hales et al., (2015), it was demostrated that the major cause of high mortality rate in backyard pig farms is diarrhea and this may be due to the improper feeding programs, bad and extreme weather conditions (too hot and too cold in some areas), anemia and blood poisoning bacteria (bacterial *Septicaemia*). Poor feeding strategies (see figure 2 and 3) during the late gestation periods in sows were also reported by Moustsen et al., (2013).During this periods, the sows tend to have weak and immature birth of piglets that may also become more susceptible to gastrointestinal infections such as *Escherichia coli* and *Salmonella spp*. In the experimental trial conducted by Toledo et al., (2012), it was reported that *Enteropathogenic E. coli* is the most gastrointestinal pathogen that causes post-weaning diarrhea usually lasting for 4-10 days.

The report by Penrith, (2013), demonstrated that although pork production in the Limpopo Province was higher, it may also dominate to the human health risk by perpetuating the incidents of some diseases such as African swine fever. As it was indicated in this paper that the majority of these farmers are unable to afford

Source: SAPPO statistics, 2014

Figure 4: South African map Highlighting Limpopo Province Pig Farming System

expensive feeds and vaccines, they are forced to produce under hush condition such as imbalanced diets, poor operational and financial management, lack of weaning knowledge, transport costs, distance from market zones, inbreeding and unstable weather conditions such as drought and lack of water, (see figure 1) which hinders their pork production(Fasina et al., 2014; SAWS, 2015). As the results, the product marketing competition becomes very tight because most of the local people prefer to buy pork produced from commercial farmers than small local farmers (Tshitangoni et al., 2010; Tibesigwa, et al., 2015).

Good feed rations/formulation to avoid pre-and-post weaning consequences in backyard small scale pig farming production to improve growth performance of growing piglets and carcass quality of finished pigs, milk production during late gestation and early lactation in sows period in Limpopo province (Campbell et al., 2013). However, most of the emerging small scale pig farmers are still illiterate and feed ration formulation in accordance with NRC requirements for pigs might still be a problem with such people. Therefore, we can recommend the available *L. edodes* as diet supplement to improve pig's performances

Economical Significance of Pigs to Small Scale Pig Farmers of Limpopo Province

Pork Production and Human Nutrition

Malnutrition in Africa is of current concern to animal nutritionists and agriculturists on human health and growth. High percentage of growing population competing for limited natural resources such as water and land becomes the major factor that affects food security (Bain et al., 2013). Pigs, like any other livestock animals, have very vital cultural, economic and social significance in communal and urban communities in Southern African countries. In Limpopo province, for example, rural pork production helps to improve household income and soil productivity. They are also used for ritual purposes and for saving household assets (IFAD, 2010; Diao et al., 2010; Christiaensen et al., 2010 and Mueller, 2011).

Most of the small rural farmers in developing countries sell their pigs in exchange for money and other goods within the community. These in turn, are used to meet other needs such as paying *Lobola* (bride price), family supports and buying feeds for other livestock animals such as birds. As the household income improves, human consumption of protein (meat, eggs and milk), which are required to fight malnutrition in communities also increases. Financial support such as loans to emerging small scale livestock farmers is another major problem. Therefore, farmers use their pigs as living asserts that help them during the unforeseen circumstances such as illness, death and accidents involving their family members. Pig farming has a direct inter-relationship with crop farming whereby pig dungs can be used to fertilize the soil for cultivating crops in the fields crop produce produce (e.g. cereals) can be used to feed pigs and other domestic animals (Moyo et al., 2010; Stroebel et al., 2011; Tembo et al., 2014)

Pork Production and Human Health

Most rural pig farmers are unable to buy vaccines to treat their animals and as results of this, human health becomes vulnerable to disease such as swine fever which are transmited from animals to humans. The lack of animal health/ disease control programs in rural communities escalates the risk of human health from animal disease transmissions. Due to the high cost of pig feeds, emerging small scale rural pig farmers in rural communities allow their pigs to scavenge to feed their offspring,but this animal movement management practice increases the transmission of diseases from pigs to humans and the spread of this disease may negatively affect the international trade of animal products, such as pork, poultry and red meat(Figure 4) (Penrith et al., (2012 and Penrith et al.,(2013); Meissner et al., (2013) ;Fasina et al.,(2014).

Figure 4: South African map Highlighting Limpopo Province Pig Farming System

Significance of *L.edodes* fungus on improving the nutritional requirements of Pigs against the malnutrition in human.

The fungus *L.edodes* contains higher percentages of fiber (both soluble and insoluble) than other nutrients such as proteins.Due to their effectiveness as supplements, they were reported to act as prebiotics (Finimundy et al., 2013). Prebiotics defines the type of non-digestible carbohydrates foods which are used as animal feeds supplement to enhance the performance of gastrointestinal tract microfloras *(Bifidobacter ,Lactobacilus,*etc) .Their major rolesis to improve the digestion in the stomach and fermentation of undigested feeds in the colon as well as the absorption of nutrients in the small intestinal. Monogastric animals have simple stomach and without digestive enzymes to catalyze prebiotic feeds, however this type of feeds can only be degraded by the colon microfloras in the (Živković et al., 2011 and Finimundy et al., 2014). Prebiotics are also capable of colonizing the entire gut system to eliminate the replication of non-beneficial bacteria/ pathogenic microorganisms (such as clostridia) (Goyal et al., 2012).

In the research study conducted by Zhao et al., (2015),as the dietary supplements of Manan-oligosaccharides in young suckling pigs resulted in a higher concentration of immunoglobulin as compared to non-supplemented piglets. Similar results were observed by Vyas et al., (2012), on growing-finishing pigs.The improvements on the production of volatile fatty acids (VFA) to help pigs meet their energy requirements was further observed. On the other hand , Goyal et al., (2012) have demonstrated that dietary supplement of *Lentinus edodes* mushroom in pig diet can influence the growth of Jejunal villus length and crypt depth due to the large number of potential microfloras *(Bifidobacteria and Lactobacillus)* colonizing the entire gastrointestinal wall. The inclusion of *Lentinus edodes* in the diet of growing-finishing pigs, sows and boars could create a very good and comfortable lumen condition for the gut health and nutrition. However, due to less recent evidence published regarding the use of *Lentinulas edodes* as pig feed additives more research is recommended in the subject area.

CONCLUSION

Malnutrition in South Africa is of great concern to professionals of both animal and human nutrition in rural communities. Livestock, pigs in particular, play a very crucial role in the livelihood of both rural and urban residents. They provide these residents with the wherewithal to fight poverty through job creations and skills development. However according to our recent research, it is evident that most of the emerging small scale pig farmers are poor and are unable to buy animal feeds and maintain and manage their piggeries. They rely on government for mentoring, financial support and risk management trainings. Government interventions, unfortunately, sometimes take longer time to reach every farmer on the ground. This therefore, results in high mortality rate of weaning piglets as a direct result of poor feeding.

The fungus *L.edodes* is recommended as the cheapest and readily available alternative feed additives that can be used by emerging small scale pig farmers of the Limpopo Province to improve the pig nutrition. This edible mushroom contains good nutritional properties such as carbohydrates (fiber), proteins (amino acids), vitamins (C, B1, B2, B12, niacin, and vitamin D) and lower in fats which makes it possible to improve the growth performance of growing pigs, carcass quality of finished pigs and milk production capacity of gestating and lactating sows.

They are also reported to have medicinal properties such as immunomodulatory and antioxidants which can help to improve the health of the pigs to avoid relying on expensive vaccines.

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