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Oligosaccharides, an Alternative to Antibiotics Growth Promotant: A Review

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ABSTRACT

Poultry industry has been rocketed due to a high demand on poultry products. In order to minimize the production cost, poultry producers have been encouraged to use antibiotics as growth promotants to maximize the production and to control disease. It is evident that antibiotics utilization in poultry industry becomes a boomerang to the poultry industry itself, since consumers have rejected poultry products containing antibiotics for its resistance to certain bacteria. Prebiotics were then used to replace antibiotics. This growth promotants; however, have some limitation such as lack viability, stability and inability to be established in the gut microflora due to its gastric acid and bile acid concentrations. Recently, another alternative has been studied. It is now recommended for the poultry producers to use safe growth promotants such as prebiotics oligossacharides. There are some classes of oligosaccharides which are obvious to be beneficial for poultry industry to produce antibiotics growth promotants free products such as fructooligosaccharides, galactooligosaccharides, mannan oligosaccharides, lactosucrose, and xylooligosaccharides. They are recommended because they usually contain of commonly consumed food such as wheat, bananas, garlic, onion and yeast. These can be good alternatives to replace the use of antibiotics growth promotants without changing the poultry production performance.

Key words: growth promotant, antibiotics, oligosaccharides, safe poultry products

ABSTRAK

Meningkatnya permintaan masyarakat akan produk ternak unggas menyebabkan pesatnya pertumbuhan industri perunggasan. Dalam kurun waktu yang cukup panjang, penggunaan antibiotic sebagai zat "pemacu pertumbuhan", telah umum dimanfaatkan oleh peternak dengan tujuan untuk memaksimalkan produksi dan menekan resiko penyakit pada unggas, serta untuk menekan biaya produksi. Adanya isu bakteri resistan yang terkandung dalam produk unggas menyebabkan konsumen menolak produk unggas tersebut. Sebagai gantinya, kemudian digunakan prebiotik yang juga merupakan zat pemacu pertumbuhan. Namun prebiotik memiliki beberapa kelemahan yaitu antara lain ketersediaan, stabilitas dan dapat menyebabkan gangguan pada mikroflora saluran pencernaan. Beberapa hasil penelitian kemudian merekomendasikan pengunaan prebiotik oligosakarida, seperti fructooligosakarida, galactooligosakarida, mannan oligosakarida laktosukrosa, and xylooligosakarida, yang merupakan zat pemacu pertumbuhan yang aman digunakan dalam industri perunggasan. Kelompok oligosakarida ini merupakan zat pemacu pertumbuhan alternatif yang tepat digunakan untuk menggantikan antibiotic tanpa mengubah performans produksi unggas.

Kata kunci: promotant pertumbuhan, antibiotik, oligosakarida, produk unggas yang aman.

Introduction

Poultry industry has been rocketed due to a high demand on poultry products. In order to minimize the production cost, poultry producers have been encouraged to use antibiotics as growth promotants to maximize the production. There has been some research on interaction between nutrition and health status (Grieshop, 2003). Moore et. al. (1946), cited in Waldroup, Fritts and Fenglan Yan, (2003), states that the first utilization of antibiotics on diet was streptomycin, which was used to more than 50 years ago. During that period, antibiotics were used to control disease and as growth promotants as well.

However, it is evident that antibiotics utilization in poultry industry becomes a boomerang to the poultry industry itself, since consumers have rejected poultry products containing antibiotics. This is due the issue of

antibiotics resistance in certain bacteria (Hooge, 2003). For example, in US and Canada, antibiotics growth promotants have been banned. In addition, in Europe, antibiotics growth promotants used are limited. Only avilamycin and bambermycin are permitted to be used on diet (Hooge, 2003).

Therefore, a new generation of growth promotants was introduced. Prebiotics were then used to replace antibiotics. This growth promotants; however, have some limitation such as lack viability, stability and inability to be established in the gut microflora. This is because of the level of gastric acid and bile acid (Kannan, Karunakaran, Balakhrisnan and Prabhakar, 2005).

Recently, another alternative has been studied. It is now recommended for the poultry producers to use safe growth promotants. Prebiotics oligosaccharides are recommended because they usually contain of commonly consumed food such as wheat, bananas, garlic, onion and yeast (Flickinger, 2003). There are some classes of oligosaccharides which are obvious to be beneficial for poultry industry to produce antibiotics growth promotants free products such as fructooligosaccharides, galactooligosaccharides, mannan oligosaccharides, lactosucrose, and xylooligosaccharides (Revington, 2002, Flickinger, 2003). These can be good alternatives to replace the use of antibiotics growth promotants without changing the poultry production performance. This paper is aimed to give a brief report on the use of oligosaccharises as growth promotants in poultry production.

Antibiotics versus oligosaccharides

Antibiotics have been used for many years to control disease and as growth promotants in poultry (Waldroup, Fritts and Fenglan Yan, 2003), to improve digestion and promote better bird performance (Barton, 2000, Pelicano et. al.,2004). With subtherapeutic dosage, antibiotics are proven to increase weight gain and feed conversion (Pelicano et. al., 2004). However, there have been many investigations on the raising effect of antibiotics resistant in humans because of consuming animal's products containing antibiotics (Revington, 2002, Waldroup, Fritts and Fenglan Yan, 2003). Therefore, the utilization of antibiotics is regulated and controlled. For example, in Australia, there are three points of control. Firstly, importation is controlled by permit system. Secondly, at registration level, the utilization is very strict. Finally, a control of use which allows the poultry producer to use them as growth promotants (Barton, 2000).

Revington (2002) stated that the issue is real. Further, resistance may be acquired through some ways such as De *novo* resistance and horizontal flow of genetic material. Single or multiple genetic mutations has been known to cause De *novo* resistance. In addition, another resistance arises through vertical flow of genetic material (Davison, 1999, Revington, 2002). For example, antibiotics resistant pathogen through the food chain and the risk of antibiotic resistance genes from animal gut microflora to human pathogen (Barton, 2000). It is known that resistance to one class compound of antibiotics tends to cause resistance to other compounds of antibiotics (Revington, 2002).

Antibiotics used in poultry production make animals products as potential reservoir which is obvious to be an entrance of this resistance into the human population (Revington, 2002). As a matter of fact, vancomycin resistance enterococci which have been widely used as human therapeutic found to accumulate in human body. A study on antibiotics residue by Low (1999) cited by Revington (2002) indicated that the level of vancomycin resistance enterococci found in Europe is much higher compared to the U.S. The observation showed that there was a very high level of vancomycin resistance enterococci found from isolated sewage, animal waste, meat products and the feces of healthy people. A decline on the level of vancomycin resistance enterococci observed in isolated meat product and gut microflora of healthy people immediately after the use of avoparcin being banned. It is obvious that some particular antibiotics used as growth

promotants in poultry production have led to a developed resistance. Then, the poultry producers use therapeutic antibiotic as antibiotic growth promotants which has been argued to be controllable. Even though, a higher use rates, it is argued the application in many ways can still minimize the possibility of development resistance which results are not known so far (Revington, 2002).

There are three strategies to promote the growth without using antibiotics growth promotants; firstly there should be regular sanitation, pest control, litter management and biosecurity to reduce pathogenic agents in the production sites. Secondly, increment of immune status of the poultry by vaccination (Revington, 2003). Finally, it is challenging to set some nutritional strategies and additives (Revington, 2002, Flickinger, 2003). This paper will discuss the nutritional strategies and additive which is focused on the utilization of oligosaccharides only.

Oligosaccharides are sweet food component, approximately 0.3-0.6 times the sweetness of sucrose. They are indigestible-water soluble substances with low energy. Therefore they can be used as low-calorie bulking agent (Flickinger, 2003). Some research using animal models showed that oligosaccharides can positively impact nutrient metabolism, improving glucose tolerance and reducing plasma ammonia and lipid concentration (Yamashita et. al., 1984 cited in Flickinger, 2003). This is an indication that certain oligosaccharides can be used to treat diabetes or renal problems.

Classes of oligosaccharides are as follows: fructooligosaccharides, galactooligosaccharides, mannan oligosaccharides, lactosucrose, and xylooligosaccharides (Revington, 2002, Flickinger, 2003). Fructooligosaccharides (FOS) are widely used since they have ability to suppress the pathogenic microorganisms and enhance the beneficial microorganisms which significantly affect the gastrointestinal health (Grieshop, 2003). Moreover, a research on different levels of FOS on diet showed that they are not digested by mammalian enzymes and go through lower instestine where they act as selective nutrients for certain bacterial populations(Tokunaga et. al., 1989 cited in Orban, Patterson, Adeola, Sutton and Richards, 1996) . Undefined cultures of anaerobic bacteria mixed with FOS on diet showed to be more effective to reduce *Salmonella spp.* Colonization than cultures treatment without FOS (Ferket,. Parks and Grimes, 2002). In human, various diets contain FOS showed to improve intestinal microbial balance and regulating colonic function (Flickinger, 2003).

Another class of oligosaccharides, mannan oligosaccharides can be extracted from various sources such as yeast and copra meal (Kannan, Karunakaran, Balakhrisnan and Prabhakar, 2005). These treatments on broiler showed a significant reduction on abdominal fat (Kannan, Karunakaran,. Balakhrisnan and Prabhakar, 2005). A study by Zdunczyk et. al. (2005) indicated that different levels of MOS on diet can decrease the *cecal E. coli*. Moreover, dietary mannan oligosaccharides (palm kernel meal) can increase non-pathogenic bacteria such as *Bifidobacterium spp*. and *lactobacillus spp*.; however this diet can reduce pathogenic bacteria such as Enterobacteriaceae group and reduce susceptibility of *Salmonella enteriditis* in young chicken (Fernandez, Hinton, and van Gils, 2002). Mannan oligosaccharides absorb pathogenic bacteria, instead of attaching to the intestinal ephitelial cells, the bacteria move through intestine. Therefore, they have been successful to inhibit the phatogenic microbes such as *Salmonella thypimurium* in broilers. It is reported that five of seven strains of *E. coli* and seven of ten strains of *Salmonella typhimurium* and *Salmonella enteriditis* agglutinated mannan oligosaccharides and *Saccharomyces cereviseae* cells (Ferket, Parks and Grimes, 2002). Yet, this also showed that dietary mannan oligosaccharides (*Saccharomyces cereviseae*, NCYC 1026) had insignificant action to reduce *Salmonella sp.* (Ferket, Parks and Grimes, 2002). A treatment of mannan oligosaccharides on dogs diet showed an increase in fecal bacteria, number of lymphocytes and increase in serum immunoglobulin IgA to represent an increment on systemic immune status. Similarly, in rats, mannan oligosaccharides can stimulate mucosal immune response. (Flickinger, 2003). A comparative study using

antibiotics and mannan oligosaccharides on turkey industry by Ferket, Parks and. Grimes (2002) indicated that although antibiotics seem to have a better growth rate, however they have potential danger which is harmful for consumers. Mannan oligosaccharides; on the other hand, has a unique mechanism which can enhance the defence mechanism by blocking the colonization and contact to pathogenic agents (Ferket, Parks and. Grimes, 2002). It can be generalized that there are certain classes of oligosaccharides which can be used as growth promoters on poultry due to their ability to create balance gut microflora.

Conclusion

Due to a high demand on poultry products, poultry producers have been trying to maximize the production by increasing the growth performance and maximizing feed conversion. In order to reach the goal, antibiotics have been widely used as growth promotants because with subtherapeutic dosage they are proven to increase weight gain and feed conversion. However, the pathogenic-bacteria resistant contents in animal product treated with antibiotics have alerted consumers. As a result, poultry producer are warned to not use antibiotics to raise poultry. Therefore, nowadays, many of poultry producers are no longer using antibiotic to maximize the production performance of poultry. Instead of using antibiotics as growth promoters, there is an alternative to promote the production. Oligosaccharides and their classes have been proven to decrease the colonization of pathogenic bacteria such as *Salmonella spp*. and *E. coli*. As a result, balance gut microflora can be maintained. However, there is a lot of research to be done to know the best level of oligosaccharides on diet and or being used with other additives to promote poultry growth.

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