

## THE EFFECT OF BETA-AGONIST (SALBUTAMOL) RESIDUE IN PORK ON CONSUMER HEALTH

ท้าวชัย ศุภดิษฐ์<sup>1</sup>

Tawadchai Suppadit Ph. D.

### ABSTRACT

*Salbutamol is a bronchodilator used for the treatment of asthma, chronic bronchitis, and other breathing disorders in humans. It functions by opening the airways and making breathing easier. At the same time, in swine production, pig farmers have used salbutamol, an anti-asthma drug, to supposedly enhance the appeal of pork by making it looks redder. Consuming pork adulterated with salbutamol over a long period have resulted in many symptoms including muscle cramps or tremors, excitement, headache, nausea, nervousness, vomiting, general body discomfort, increased appetite, increased blood pressure and over activity. Although, the Ministry of Public Health of Thailand has issued a regulation forbidding the use of salbutamol in swine domestication and the import salbutamol. Some pig farmers still use salbutamol in diet and therefore pork contaminated has still been found. To avoid buying pork that is adulterated with salbutamol, consumers should look for pork with fat because pigs that have been given salbutamol usually have either low amounts of fat or none at all. If the color of pork is a bright red, consumers can assume that salbutamol is presented.*

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<sup>1</sup> Asst.Prof., The Graduate Program in Environmental Management, National Institute of Development Administration.

## **INTRODUCTION**

The term “pork quality” has different meaning. Pork quality in terms of pork processing involves functional property and color of the muscle for producing the good appearance product. For retailers, it relates to the maximum muscling and moderate fat. For consumers, it relates to pork consuming satisfactory involving color, taste and tenderness. On the other hand, consumers always decide to buy pork in terms of good nutrition and safety (Ensminger and Parker, 1999). According to pork consumers, they prefer meat that is red and low in fat content. They know that high fat will increase the risk of heart disease, circulatory disease, over-weight and high cholesterol level in the blood circulation (Faculty of Veterinary Science, 2003). As a result of consumers’ preference, butchers and other retailers can earn more money from the maximum lean meat and less fat. Thus, the pig farmers purposely produce pigs in such a way that they meet to consumers’ requirement. In the present, the only way that the pig farmers can do is to improve their pigs by treating with beta-agonist drug. This can be done by adding the drug into the pig diet as well as in drinking water. The most common drug in this group is salbutamol.

## **PHARMACOLOGY OF BETA-AGONIST**

Beta-agonist drugs are the drugs that affect on beta-agonist receptors. The beta-agonist receptors are divided into 3 groups; beta-1-agonist receptor, beta-2-agonist receptor and beta-3-agonist receptor (Korthumarit, 1999). Beta-receptors are located at all tissue in the body. The beta-1-receptor is always found in juxtglomerular and cardiac muscle. The beta-2-agonist is located at the smooth

muscle of blood vessel, trachea, urinary tract, genital tract, gastrointestinal tract, liver and skeletal muscle while the beta-3-receptor is found mainly in adipose tissue. Epinephrine, ephridine, clenbutarol, salbutamol, cimaterol, terbutaline and ractopamine are drugs in the beta-agonist group (Korthumarit, 1999; Rittitit, 1997).

## **PHARMACOLOGY OF SALBUTAMOL**

Salbutamol is the therapeutic bronchodilator drug in asthma that affects the beta-2-receptor. It functions by expanding the airways and making breathing easier. In livestock production, beta-agonist is used in swine to increase red meat. The characteristics of salbutamol are a white crystalline powder, soluble in water, and slightly soluble in chloroform and ethanol. It is unstable in the light. Salbutamol is well absorbed onto the gastrointestinal tract. The inactive form of salbutamol is salbutamol sulfate (Keefe, 2000; Korthumarit, 1999). Salbutamol is metabolized form of salbutamol sulfate in the liver and secreted in the urine and feces as salbutamol and its metabolized form (Korthumarit, 1999). Approximately 75% of a single dose is excreted in urine within 72 hours, mainly as salbutamol sulfate, and about 4% excreted in the feces. The half-life of salbutamol in the human body is reported to be 2.7-5 hours after oral administration. Salbutamol can cross the blood-blain barrier and placenta (Keefe, 2000). A distribution of salbutamol in swine was studied and the result showed the high concentration of the drug in serum 5-hour after the last administration of salbutamol. The disposition of salbutamol in various swine organs after feeding was investigated. The highest concentration was found in the liver and kidney whereas the low

concentration was found in the muscle and fat. The absorption half-life of salbutamol in swine was  $4.01 \pm 0.20$  hours (Poomvisee and Ingkaninun, 1994).

## DETECTION METHODS

There are many methods used for detecting beta-agonist residues. Multi-residue analysis of beta-agonist in urine and liver samples using mixed phase columns with determination by radio-immunoassay was reported by Collin (Collins *et al.*, 1994). The enzyme immune assay (EIA) test kit is the screening test that was produced for determining beta-agonist residues. The lowest limitation to detect salbutamol in meat is 0.2 ng/g (Collins *et al.*, 1994). Gas chromatography-mass spectrometry (GCMS) is a highly specific and sensitive method for evaluation of beta-agonist residues in muscle and serum. GCMS method could detect salbutamol in the lowest levels between 0.1-0.5 ppb. The recovery rates were 70.3% in swine meat and 77.0% in swine serum (Tung Fa, 2000). The high performance liquid chromatography (HPLC) is one of the methods used for detecting beta-agonist. The lowest limit of detection salbutamol in meat by HPLC method with solid-phase extraction is 55 ppb. This method used 0.05 M phosphate buffer-MeCN as a mobile phase (Collins *et al.*, 1994).

## THE EFFECT OF SALBUTAMOL ON SWINE CARCASS AND MEAT QUALITY

Salbutamol has been used to mix in swine diet for many years. The purposes of the use of salbutamol are to increase the muscle texture and to decrease fat (Korthumarit, 1999). It is believed that meat from improper

salbutamol-fed pig will be contaminated with salbutamol residues. Thus, impacts on salbutamol residues in pork will affect the export of pork to other countries and may harm consumers. Because of the high possibility of salbutamol residues in the meat, the government (Ministry of Public Health) of Thailand has passed a regulation forbidding the use of salbutamol to bring up pigs. Nevertheless, some pig farms still use salbutamol.

Meat quality in the terms of food safety means meat from a healthy animal, free from microorganisms, free from veterinary drug residue and/or other chemical substances (Jaturasitha, 2000). The European Union countries have set up the maximum allowance residue of beta-agonist in meat. For instance, in Switzerland the maximum residue of clenbuterol in animal production food is limited at 1  $\mu\text{g}/\text{kg}$  (Salleras *et al.*, 1995) (clenbuterol is a drug in the beta-agonist group) while the maximum residue of salbutamol in the meat has never been set up. The use of salbutamol in pig production is illegal in Thailand and almost all other countries.

Beta-agonist (salbutamol) can improve swine carcass and meat quality. There have been many experiments on the effect of different dosages of salbutamol. Salbutamol at the level of 3 ppm could produce carcasses that were less fat and had larger loin muscle areas. Nonetheless the growth rate was not affected when salbutamol of 3 ppm was used. There were no differences in pH-value, drip loss percentage between treated and control pigs (Warris *et al.*, 1990). Furthermore, an increase in growth rate, percentage of carcass percentage of lean meat and loin muscle area in Large Whites were not statistically significantly different between treatment (4 ppm) and control group (Tubcharoen *et al.*, 1995). Salbutamol at the level of 8 ppm improved feed conception rate, growth rate,

carcass percentage, lean meat percentage and loin muscle area in cross-bred pigs (local breed x Meishan) when compared to untreated group (Tubcharoen *et al.*, 1995). An increased length of carcass, decreased back fat thickness and the index value between back fat thickness and the width of the loin muscle were found when swine were fed with salbutamol at the level of 15 ppm. The proportion of muscle area, back fat area and the total percentage of lean in muscle were also increased (Siththigripong, 2002). The other reports showed that meat quality in terms of tenderness, color, muscle pH and crude muscle fiber were decreased while the water-holding capability of the protein was increased (Sethakul, 2002).

#### **THE LEVEL OF SALBUTAMOL RESIDUE**

Pigs fed with salbutamol at the level of 6 ppm for 15 and 30 days were investigated so as to detect salbutamol residue in pig's urine by HPLC technique. It was found that the salbutamol residues were 388.7 and 1,404.1 ng/ml, respectively. Treated pigs for 15 and 30 days were also studied for the level of salbutamol residue in liver, kidney, meat and fat after they were slaughtered. The levels of salbutamol residue in liver were reported at 2,210 (15 days), 2,236 (30 days) for after 3-day withdrawal and 1,757 (15 days), 1,783 (30 days) ng/mg for after 7-day withdrawal, respectively. In kidneys, the salbutamol residues were found at 1,453 (15 days), 1,679 (30 days) for after 3-day withdrawal and 1,000.3 (15 days), 1,070.2 (30 days) ng/mg for after 7-day withdrawal, respectively. Nevertheless, the level of salbutamol residue in the meat and fat also treated 15 and 30 days and 3- and 7-day withdrawal were lesser than 10 ng/mg (Hashimoto *et al.*, 1995).

## **SIDE EFFECTS OF SALBUTAMOL**

The hazard of consumption of contaminated meat with beta-agonist may increase the risk of heart disease and high blood pressure. There have been reports about poisoning by beta-agonist. In 1992, there was a report from Catalonia in Spain on poisoning 113 humans after they consumed veal's liver. They developed signs of nervousness, rapid heart rates, muscle pain and headache (Salleras *et al.*, 1995). An outbreak of poisoning of 15 people, after consuming meat in Italy was reported. Clinical symptoms were distal tremors, palpitations, headache, etachipnoea-dyspnoea and also moderate hyperglycemia, hypokalemia and leucocytosis (Brambilla *et al.*, 2000).

The side effects of salbutamol include muscle cramps or tremors, excitement, headache, nausea, nervousness, vomiting, general body discomfort, increased appetite, increased blood pressure and over activities. Rare side effects involve hypokalemia, heart failure, hypertension and severe cardiovascular disease. There was no teratogenic and mutagenic effect when a drug was tested in the Ames test. Nevertheless, there were some reports on the incidence of benign leiomyomas of mesovarium in rats related to the increase of dose of salbutamol (Keefe, 2000). Also mice were treated with 2.4 mg/kg of salbutamol found the positive C-mitotic effect accompanied by an increased mitotic index and decreased frequency of anaphase in bone marrow cells, which may induce aneuploidy (Sujatha and Hedge, 1999). Nevertheless, the effect of salbutamol residue in pork has never been reported in Thailand.

## **CONCLUSION**

Nowadays, there are many methods for detecting salbutamol residue in meat such as EIA, HPLC and GCMS. Nonetheless these methods are expensive and are difficult to carry out in the short period of time. As a consequence, individual consumers cannot use these methods to detect salbutamol residue by themselves. Without their knowledge, the consumers may still be at risk from consuming pork contaminated with salbutamol. The effects of salbutamol residue in pork on human health are still suspected and also a level of salbutamol residue harming human health is not clear. Although the Ministry of Public Health of Thailand is regularly surveying pork in the market in order to control pork quality and contamination, pork contaminated with salbutamol is still frequently found.

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