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## THE STUDY OF SUSTAINABLE PIG PRODUCING PRACTICES

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**ABSTRACT** This paper is a general introduction to the technique of quality ecotype pig production process as well as its quality assesment. The purpose of this study, was the safeguard of consumer health, the sustainable production of food, based on to ecological theorithec al paratices applied to the management of the pig farms, by using high yielding quality grass as daily feed. In order to prevent and cure diseases in the farm, Chinese medicinal herbs were used to replace western medicine. In this model, a methane generating pit was built and the water leathc from the methane pit was used for irrigating grass, which helps reduced traditional environmental pollution caused by pig farming. The feeding model applied “Pig – Methane - Grass” brought about remarkable economic and social benefits, which also opens up a new territory in the field of ecological environmental improvement based on a locally intergrated economic model.

**Keywords:** ecotype pig; Feeding mode of “Pig – Methane - Grass”; Pennisetum purpureum Schum, Chinese medicinal herb; environmental pollution

### INTRODUCTION

In today's consumer trends, people call back to nature, looking forward to pollution-free ecological food, green food and organic food. Production of chemical pollution-free, without residue, high-calcium, low-cholesterol meat, and resolve conflicts in pig industry and environmental protection is becoming a hot research topic. Especially in recent years, when a part of our agricultural products, animal products and aquatic product facing the international market technical barriers and green fortress, our export suffered from setbacks. We should greatly develop ecological products and organic foods which can benefit consumers' health and meet international market demand have become our top priority. Our research group after years of unremitting efforts and regard ecology theory as a guide, using high quality forage and feed as the pig diet, herbal feed additives prevent and cure disease, in accordance with the "Pig-Methane-Grass" standardized breeding project mode to feed Eco-pigs in bulk and using high-quality Ecotype pig to process high-quality "HE JIA " brand pork and meat products on sale in August 2003. Eco-farms are classified as demonstration farms by environmental protection departments, which create good economic and social benefits, creating a new path to solving the

environmental pollution caused by pig and drug residues in pork. The "Pig-Methane-Grass" project, and ecological pig production technology is as follows:

## 1. Materials and Methods

### 1.1 Materials

*Pennisetum purpureum* Schum is the Gramineae C4 plants with fast growth, high yield, high content of crude protein and various vitamins and trace elements. It is not only a good solid-earth plant in soil and water conservation in southern China but it is also a high-quality green feed and protein feed. It also has the ability to absorb a large number of sewage wastes from pig farms.

**Table 1 Ingredients and Composition of *Pennisetum purpureum* Schum**

energy	crudeash	% CP	% CF	% EE	% moisture	% Na	Mg	K	Ca	P	Lys	gly	leu	□k.cal	kg—1	□
3860	11.27	23.69	25.23	2.27	6.83	134.15	2166.5	1	2030	0.23	0.37	1.02	1.50	1.23		

Note Analysis of data from the Chinese Academy of Sciences Institute of Animal Husbandry and Veterinary Medicine

### 1.1.2 Test Drug

Western medicine is zinc bacitracin; use herbs and plants as feed additives, use different proportions houttuynia, barbata, Bupleurum, Poria, haw in formula, in order to ensure Chinese herbal medicine active substance without losing the integrity and live , using Chinese multi-function extractor soaking, boiling, filtration, vacuum spray and dry to made pure medicine powder.

### 1.1.3 Experimental Animal

Select the same genetic quality, weaning age, similar gender ratio healthy DIJY feeder pigs 108 pieces. Weight about 25 kg. No significant difference between the groups, each group 36piece, 6 replicates, each barrows and sows takes 50%.

### 1.1.4 Feed Diet Composition

Eco-pig feed comes from the farms with the same experimental base diet composition and dosage. The diet is composed by green feed and concentrates .Feed formulation and main nutrient contents are in Table 2. The corn, soybean meal and other raw materials in the diet come from non-pollution or "green food" which is authenticated at the place of origin. The main use of green fodder and forage after beating smash fed concentrated feed mix.

**Table 2 Ingredients and Composition of the Base Diets**

Material	Proportion	%	Major nutrients and contents
Corn	65.0	DE	□MJ/kg
Wheat bran	5.0(15.0)	CP	□%
Soybean meal	16.7	Ca	(%)
Stone dust	1.0	Total phosphorus	(%)
DCP	0.5	Lys	(%)
Salt	0.3	CF	□%
<i>Pennisetum alopecuroides</i>	10.0(0.0)		
Plant oil	0.5		

Premix 1.0  
 different growth stages Eco-pig concentrate / forage feeding volume

**Table 3 Diets Composition of Ecotype Pig in Different Growing Period (kg·d<sup>-1</sup>)**

Weight (kg)	Mixed Concentrate	Fresh grass (Pennisetum alopecuroides)
25—60	1—1.5	1.0—2.0
60—80	1.5—1.8	2.0—2.5
80—110	2—2.5	2.5—3.5

## 1.2 Methods

### 1.2.1 Experiment Design

Take Ecological mode pig as experimental group 1, according to the feeder pig growth phase characteristics. experimental group 1 used herbal feed additives and nutritional feed additives premix, adding 300g per ton in experimental group premix; experimental group 2 use Western antibiotics and nutritional feed additives make up 4% Premix, using bacitracin as antibiotics; test group use 3 nutritional feed additives make up 4% premix, except nutritional feed additives, contains no antibiotics. 5 days Pre-trial test, the 30 days formal trial period, fasting weighed at the end of feeding trial, Pig bed is area of 300 cm × 250 cm. Test pigs were fed unlimited, 2 times a day, record daily feed intake, free water. 5 days Pre-trial test, 30 days formal trial period, the actual test time is 35 days.

### 1.2.2 Test Environment and Feeding Management.

Feeding and management of Eco-pig use herbal feed additives, except vaccine for normal immunization, usually use herbs and plant immunomodulators to replace medicine as feed additives and antibiotics. According to different various growth stages, using different herbal feed additives for disease control and epidemic prevention Plant Evaporating. According to various growth stages of eco-pig physiological characteristics, body weight 30kg-60kg stage in order to improve the pig immunity. Premix is made by the eco-farm, then adding 0.2% -0.3% in concentrate; during 60 kg-100 kg stage in order to improve digestion and digestion and invigorating the spleen, lower cholesterol, adding 0.1% -0.2% in concentrate. In order to verify the herbal feed additive on the Ecotype pig immunity, the research group carries out the comparative test between Chinese herbal medicine, western medicine group and control group.

### 1.2.3 "Pig-Methane-Grass" Standard Feeding Project Mode

The "Pig-Methane-Grass" standard feeding project mode is not only an important part of the pig industry but it is also an essential part of environmental pollution. Use LuSheng Xing farm and LiuXing farms as example, in this experimental mode, accord to the proportion that 100 pigs with 1 acres Pennisetum. Eco-farm digesters standard is three pigs / 1m<sup>3</sup>; pig manure (residue) is used to produce Bio-organic fertilizer; manure enter digesters, biogas for farm lighting and insulation work, after fermentation, precipitation of biogas slurry is used to irrigate Pennisetum land, overall use of "Pig- Methane-Grass" farming methods. 1 Million pigs can make 800m<sup>3</sup> of anaerobic digesters and 500m<sup>3</sup> Pools, Pig manure residue after fermentation then add Biological cultures

can make into organic fertilizer for agricultural or horticultural use, an ten thousand- pigs farm can produce about 5,000 tons of organic fertilizer per year.

#### **1.2.4 Pork Inspection Comparative Test**

In order to verify the economic and social benefits of eco-farming, comparison tests were carried out between common pork and Eco-pork. The tests include analysis of the nutrient composition of Pennisetum, Pennisetum and herbal feed additive on the ecological role of pig's immunity and pork quality, test indicators include blood immunoglobulin and cholesterol. Blood was tested by the Second People's Hospital Laboratory of Xiamen; meat quality and meat cholesterol level tested by Chinese Meat Quality Supervision and Inspection Center together with New Territories, Hong Kong, Tai Po Industrial Standards and Testing Centre.

## **2. Results and Analysis**

### **2.1 Ecotype Pig Growth and Fattening**

Eco-pig transfer feeding after weight is 25 kg, because of herbal plant feeding as health protection in feed period, few diseases disappear, if some pig on set should strictly follow the □ Green Food Production Guidelines for the Use of Veterinary Drugs□to treat, if use special drugs should be documented in the file, not allowed to sale as Eco-pig .When 90 kg-110 kg Eco-pig was slaughtered, but because the special, has its own inherent growth phase, did not use antibiotics, growth hormones and other fattening weight agents, decompose more fat to increase pork quality, the slaughter days normally is 8 d-10 d later. Normally Pig slaughter days is 165 d, slaughter days of Eco-pig is about 175d.

### **2.2 Immunoglobulin in Eco-pig Blood and other Biochemical Indicators**

In order to verify herbal feed additives effect on the ecology Immunization indicators, before slaughter, sampling the blood to biochemical testing and immunoglobulin testing. From the test results, pigs which were fed with herbal feed additives Eco-pig blood immunoglobulin IgA, IgM, IgG is higher than the other two groups. From the test data analysis: Chinese herbal medicine group than in the western group and blank control group, which increased the concentration of IgA in 10.12% (-P <0.05) and 15.02% (P <0.01); IgM were increased by 14.10% (P <0.05 ) and 25.22% (P <0.01); IgG increased 12.32% (P <0.05) and 15.22% (P <0.01).Immune globulin is a kind of globulin that stimulated by antigen and also can interaction with specific antigen, IgG which have antibacterial, antiviral effect and can lose their toxicity in and toxins, regulating aggregation and precipitation antigens it is the most important in the humoral immune substances. IgM combine with complement in the body after infection by the pathogen, dissolved pathogens; IgA addition to antibacterial and antiviral effect, on the, digestive also plays an important "barrier" role on body respiratory and other local mucosal immunity.

Also known from the test results, biochemical indicators in Ecotype pig blood are higher than the other two groups. The Chinese herbal medicine group is higher than the western group and blank control group, TP content increased by 12. 48% (P <0.05) and 16.54% (P <0.01); ALB levels were increased by 10.08% (P <0.05) and 11.28% (P <0.05); CLO levels were no significant

differences among these 3 groups( $P > 0.05$ ). Blood serum total protein (TP), albumin (ALB), globulin (CLO) levels reflect the body's absorption and metabolism of protein, means that Eco-pig, after taking Chinese herbal medicine to the body through a variety of energy increased. From the test results we can also see three groups of total cholesterol (CHO) and triglyceride (TG3) shows no significant difference ( $P > 0.05$ ), but the indicators of CHO and TG3 in Eco-pig is lower than other two groups, indicating herbal feed additives also can reduce the CHO and TG3.

**Table 4 Immune Globulin Indices of Ecotype Pig Blood Compared with Common Pig Blood**

Item	Pre-trial			After-trial		
	□	□	□	□	□	□
IgG/ g•L -1	3.836±0.182	3.842±0.190	3.848±0.184	4.656±2.266	4.268±0.200	4.088±0.188
IgM /g•L-1	0.502±0.038	0.509±0.032	0.505±0.036	0.721±0.028	0.668±0.038	0.593±0.032
IgA/g•L-1	0.628±0.026	0.616±0.028	0.622±0.031	0.782±0.052	0.734±0.029	0.712±0.026

\*□ = Herb group □ = chemical medicine group □ = control group

**Table5 Effect of Chinese herb feed additives on the biological and biochemical index of blood in ecotype pig**

Item	Pre-trial			After-trial		
	□	□	□	□	□	□
TP/ g•L -1	49.72±2.42	49.86±2.78	49.84±2.72	64.92±3.54	58.73±2.91	55.85±3.22
ALB /g•L -1	33.23±2.23	33.45±2.12	33.56±2.08	46.72±2.02	41.66±2.13	39.52±2.22
CLO/g•L -1	16.62±1.22	16.86±1.18	16.74±1.09	18.28±1.05	17.34±1.09	16.71±1.06
CHO/ g•L -1	1.92±0.22	1.96 ±0.19	1.98±0.25	1.88±0.24	2.04±0.29	2.01±0.16
TG/ g•L -13	1.03±0.14	1.04 ±0.16	1.03±0.15	1.88±0.24	2.04±0.29	2.01±0.16

\*□ = Herb group □ = chemical medicine group □ = control group

Note data provided by Xiamen Second People's Hospital laboratory

### 2.3 Ecotype Pork Quality and Cholesterol Detection

When detected Cholesterol before slaughter, we did not only detect Cholesterol in blood but also detect Cholesterol in the eco-pig. Detection and data results show that the eco pig cholesterol contains only 1/3 Cholesterol of common pork, but the Eco-pig unsaturated fatty acids in Eco-pork is higher than common pork. Unsaturated fatty acids play an important role in reducing cholesterol absorption in human body. As we all know, saturated fatty acids are a type of fatty acids which can induced atherosclerosis, elevated blood lipids, elevated serum cholesterol concentration. It can promote the absorption of cholesterol in the body, elevated blood cholesterol levels, is also easy to combine both of them and deposit in the vessel wall, is the main reason for angiosclerosis. Saturated fatty acids and cholesterol also lead to serum cholesterol and LDL-C increased, but the saturated fatty acids is just the opposite, it will lower cholesterol, cholesterol and other indices in Eco-pork and common pork can be seen in table 6.

### 2.4 "Pig-Methane-Grass" Standard Feeding Engineering Model Combine Effect

"Pig-Methane-Grass" standard feeding engineering model combine effect has been full carried out in the GuoRong belonged farms, each eco-farm pigs designed Biogas by 3 pigs accord with 1 m<sup>3</sup>, totally more than 3000 m<sup>3</sup> digesters, organic fertilizer factory can produce 8,000 -10,000 tons of organic fertilizer per year, can handle 20,000 tons of fresh manure. Manure enter digesters,

biogas for farm lighting, after fermentation, precipitation slurry is used to irrigate Pennisetum, Pennisetum is a kind of pasture which like a lot of fertilizer and water, the slurry is very suitable for Pennisetum and can make it grow faster, more tillers, renewable strong, its forage quality is especially good, the crude protein can improve 35% in vegetation period, watered with biogas slurry can make it grow rapidly, 100 pigs accorded with 1 acre Pennisetum is very reasonable. In summer extra silage can also be stored. "Pig-Methane-Grass" engineering mode optimize the pig farm environment and after tested by the relevant authorities, accord to environmental protection standards (0emissions), granted as "Eco-farms" by the environmental protection sector.

## 2.5 Ecological Pork Processing and Marketing

Processing with high-quality Eco-pig "good cooperation" brand pork and processed meat products to implement the cold chain, cold chain transport and cold chain sales, that is Eco-pig into the meat processing factory, after quarantine after the slaughter. Carcasses immediately after slaughter into the 0-4 low temperature environment (cool shop). Handlebar with a frozen cold chain transport of pork from the meat processing delivered to the 14 direct sales stores and supermarkets, refrigerated trucks and refrigerated containers for sale at 0-4 constant temperature environment, thus effectively avoiding the ecological pork "secondary pollution."

Eco-pork price can be 20% -50% than common pork, lean meat and meat prices is 30% higher than common pork, visceral, pork spare ribs price is 50% higher than common on sale for recent years, Eco-pork won consumers recognition by its hygiene, healthy, nutrition, good taste .

## 3. Discussion

### 3.1 High Quality Ecotype Pig Production Technology and "Pig-Methane-Grass," Engineering Model Birth Process

As people's living standards improving and consumers' animal food health care consciousness enhancing, global concerns about food security and calls for agricultural sustainability become stronger and stronger. Meanwhile GMF on human health and biological diversity security are still called into question particularly western medicine and antibiotic residues in pork, poison the human body and side effects, so that consumers and markets have become increasingly demanding on pork quality - especially in the international market and the Hong Kong and Macao pork market and the pursuit of more eco-advocate safety of high-grade type of pork, for which frequently between Hong Kong businessmen in the Mainland, to find opportunities and partners, want the ecological agriculture can have a corresponding variety of ecological animal products [2], especially Eco-pork. After Xiamen GuoRong Company and Hong Kong first Biological Engineering Technology Co., Ltd. was informed □Livestock Production Optimization Model□ presided by Fujian Agriculture and Forestry University was granted National Prize for Progress in Science and Technology Award ,and successfully use Pennisetum raise Eco-pig, they employ Chinese Academy of Agricultural Sciences and the Fujian Agriculture and Forestry University, experts and professors to set up GuoRong Bio-Economic Research Institute of Xiamen immediately, investigate high-quality Eco-pig production technology, decided to Xiamen, Ming Hui-food company six pig farms as experimental unit, adopt "pig-Methane-Grass" project mode Eco-pig technology to produce" HE JIA "brand pork and launch on market successfully. Therefore, high-quality Eco-pig production is the product of the times that matches

the consumer needs and is not only an achievement cooperated by Scientific Research intuition and enterprises, but also a Practice results made by livestock veterinary practitioners and primary farm.

### **3.2 Pig - Methane-Grass Mariculture Accord with Ecotype Pig Feeding Mode**

Use of high quality forage and feed combination diet, using herbal botanical feed additives prevent disease, in accordance with the "Pig-Methane-Grass" standard raising mode, making use of organic manure fertilizer residue, liquid dung enter the digester and biogas for farm lighting, biogas slurry water Pennisetum, comprehensive recycling. This mode changes the environment-pollution of traditional technology, and meets the Eco-feeding pattern.

### **3.3 Development of Eco-pig Farming Production is an Effective Approach to Producing Quality-assured Meat, Safe Meat and Healthy Meat.**

China has become the pig industry dominant country in the world. Amount of pig breeding, pork production and per capita possession of pork are all the No. 1 in the world. The pig farming industry has been greatly developed, but also emerge many new defects. Especially swine disease and the epidemic has not been control and eradication completely, to the opposite, appeared a number of new diseases. On one hand, due to the abuse of medicine, many viruses and bacteria developed drug resistance; create new difficulty for clinical treatment, on the other hand Western medicine residues in the meat seriously endanger the health of consumers. But use high-quality forages and herbal feed additives to replace Western medicine and antibiotics in pork production , not only can improve immunity and disease resistance of pigs, but also promote the growth of pigs, using no antibiotics, hormones and chemicals during the feeding process ensure the safety of pork, is better for human health and has good social benefits. It is not only point out Strategic direction in research and development on the pig disease prevention and treatment but also opens an effective way of producing quality-assured pork, safety pork and healthy pork.

### **3.4 Ecotype Pig Create Good Economic Benefit for Farms**

Reducing feed costs is the problem that improving pig industry economic benefit wants to solve. Modern scale of pig raising use cereals, legumes and other processing by-product concentrate feed as base diet, but feed resource is the main factors which restrict China animal husbandry. In Southern China the corn, soybean and other required raw material required in pig industry feed mainly come from the north or abroad. The use high-quality Pennisetum as main green fodder in Eco-pig, according to the nutritional content table of the Pennisetum, it is a kind of high-energy forage rich in vitamins and trace elements, after beating along with concentrate feed to feed pig, it is easy to satisfy a pigs nutritional needs and reduce feed costs. It contains significant feeding nutritional value, saving 1 / 4 of concentrated feed, produce good taste pork, each Pig can cost 25 Yuan. Eco-Pork price is 20% -50% higher than the common pork; each pig can be sold extra 25 Yuan. Thus, include cost-saving, medical expenses, procurement price and other benefit, raising eco-pig each one can increase at least 50 Yuan, the annual slaughter 10,000 pigs farm can get more 500,000Yuan. Pennisetum up to 30,000 kg per year or more, but also for cattle, sheep, rabbit, poultry, fish, etc., significantly reduced feeding costs and improve economic efficiency.

### **3.5 “Pig-Methane-Grass” Modes have Significant Ecological Benefits in Protecting the Environment.**

Pig Farms has inevitable damage on environmental and ecology, manure and sewage treatment has always been a thorny problem. The Eco-pig feeding pattern use bio-fermentation processing manure, organic fertilizer production can be sold, fermented slurry is used to irrigate pasture and can make complex utilization. It is a fundamental solution to the long-standing contradiction between livestock development and environmental protection. In addition, the grass can conserve soil and water, Prevent soil erosion, also provided a good environment for pasture, forage base and other construction projects, it does not matter for the Aquaculture industry development or environmental protection as this is a sustainable, healthy mode. In accordance with the "Pig-Methane-Grass" model farms to be built in several ecological Xiamen Environmental Protection Agency as a "pig model of ecological type field", "national pigs live reserve base field", pasture and forage base for other construction projects are provide a good local environment for the breeding industry to find a way out. The ecological benefit is significant. On July 6, 2004 Fujian Provincial Animal Husbandry integrated Pollution Remediation on-site meetings was held in “demonstration base” LuSheng pig farms. on July 19,2004 Fujian Comprehensive Television Channel also use" a 14-minute dossier reported the "from ecological management to the circular economy", sing high praise for the "Pig-Methane-Grass," pig-keeping mode. Chinese Academy of Sciences, Chinese Academy of Agricultural Sciences and the relevant agricultural university professors and experts, as well as provincial, municipal agriculture, environmental protection, the CPPCC, the NPC and the governors go to visit and study the "Pig-Methane-Grass," pig-keeping mode. In 2005 Summer Xiamen First High School green activities choose Xiamen Liu Xing pig farm as ecological observation fields, Eco-farms seem to have become touristy. Students say even the pigs in the beautiful sea-side garden city live a garden-life.

### **3.6 High-quality Ecotype Pig Production Technology and "Pig-Biogas-Grass" Engineering Mode Accord with the Current Circular Economy.**

Development of circular economy is to make full use of resources and improve resource utilization, reduce environmental pollution. "Pig–Methane-Grass" farming model is a simple but scientific cycle economic mode. Growing grass to feed pigs, pig manure wet and dries separation, dried manure as organic fertilizer, sewage wet manure fermentation gas to generate electricity and biogas slurry water Pennisetum and use Pennisetum as pig fodder, which makes farm environment to achieve zero emissions. The part which used in Biological food choices not participate in effective conversion can also be transformed into use, conversion, thus greatly improving the efficiency of energy conversion, creating good economic and social benefits, in accordance with the current cycle of economic development.

### **3.7 High quality Ecotype Pig Production Technology and "Pig-Methane-Grass" Engineering Mode Prospects, Social Benefits**

High quality Eco-pig production technology and "Pig - Methane-Grass" project mode provides technical support to building a stable "safe meat" base. Because the products are eco-type pork, is pollution-free and safety food, is able to withstand the fierce market competition, integrated with world trade, opened new ways for production of high-grade pork brand (high calcium and low-cholesterol pork). It not only makes contributions to increase the exports of meat, it also improves



credibility on the international market but also Provides the possibility for further research and development of natural plant feed additives into series, industrialization and internationalization.

The Eco-pig feeding mode also promote the local farming industry and the public welfare, Eco-pig feeding mode adopt the form of company plus farmers, pasture and pigs need a lot of labor resources, forage base, bio-fertilizers and Eco-farms can arranged Employment in the pig population. Arrange the surplus labor employment, poverty alleviation and support the public service, have very high social benefits.

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