Journal of Animal and Veterinary Advances 2 (8): 457-461, 2003
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Performance of Weaning Piglets with Inclusion of *Sarcandra glabra* (Thunberg) Nakai Powder and Hot Water Extract in their Feed

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Abstract: Weaning is an essential but a stressful managerial practice in commercial swine husbandry. This is crucial period that influences the all round health and growth of the piglets. Modern day commercial pig farming has drastically reduced the weaning age and that makes post weaning care and management even more vital. Proper diet and sound management and protection from diseases are keys to the success of weaned piglet's future growth. Diets of weaned piglets are fortified with many supplements and additives intended as growth promoters. Sub-therapeutic level of antibiotics in feed is widely employed to increase weight and improve feed efficiency in swine farming. Many nations and the European Union have restricted the sub-therapeutic use of some antibiotics in swine feed. This has led to the adoption of alternatives to antibiotics that can generate similar benefits with minimal undue complications. Herbs and herbal mixtures have been in the top of the list of alternatives to antibiotics. There is a need to further investigate different herbs that can be employed for the purpose as available information in this subject is found to be limited. In the same line we investigated the effects of employing *Sarcandra glabra* as growth promoter in swine feed and monitored the performance of the weaned piglets. Sixty piglets were kept under different diets and allocated into four groups with three duplicates. The pigs were fed pre-starter and starter diets *ad libitum* for first two and second two weeks of the experiment respectively. In the pre-starter phase, the treatments were: Group 1: Basal diet (control); Group 2: Basal diet + 55 ppm Levamisole (positive control); Group 3: Basal diet + 0.4% dried herb powder; Group 4: Basal diet + 0.064% water extracted herb powder. In the starter phase, the treatments were as follows: Group 1: Basal diet (control); Group 2: Basal diet + 55 ppm Levamisole (positive control); Group 3: Basal diet + 0.05% dried herb powder; Group 4: Basal diet + 0.008% water extracted herb powder. Daily feed intake, weight gain, feed conversion ratio (FCR) and other parameters were monitored for a period of four weeks. Extracts of *S. glabra* in the diet improved the daily feed intake and daily weight gain significantly ($p<0.05$) over the rest of the groups. Feed conversion ratio (FCR) for the entire experimental period of 28 days was significantly lower in the powdered herb and herb extract treated group. No statistical test was conducted for the diarrheic condition of the piglets, but overall it was found that the incidence both for the numbers of piglets and days of persistent diarrhea was lower with levamisole and *S. glabra* extract incorporated feed groups. The current work revealed that *S. glabra* extract has potency superior to that of levamisole as a growth promoter in swine feed. The exact mechanism how the herb extract contributes to enhanced performance in weaned piglets is a matter of further investigation.

Key words: Weaning, piglets, growth, *Sarcandra glabra* (Thunberg) Nakai

Introduction

Natural weaning period in pigs is decided by factors that ensure safe self-survival of the young ones. Human intervened weaning is however a stressful activity for piglets and involves their physical, physiological and emotional changes. Profit guided swine enterprises have drastically reduced the weaning age of piglets. In-spite of sufficient regulation for weaning at no less than 3 weeks (von Borell, 1996) newer medicated/segregated weaning strategies may incorporate weaning at 7-14 days of age (Pluske *et al.*, 1995). This has made the weaned piglets susceptible to various diseases with pre-weaning diarrhea as a common complication that results into huge economic loss. Stress related compromised immune system and exposure to pathogenic microorganism in the new environment are considered the main diseases precipitating factor. Gastrointestinal disorders in neonatal or post-weaning piglets are most common and are caused by wide range of pathogens. Porcine post-weaning colibacillosis (PWC) caused by enterotoxigenic *Eischeria coli* (*E. coli*) bacteria is an increasing problem in swine farming (Nagy and Fekete, 1999 and Amezcua *et al.*, 2000). Virulent strains of *E. coli* infection in Taiwanese pig farms have been a tough challenge to veterinarians here. In spite of medical intervention in some cases 20% of the piglets died within several days of the onset of the disease. *E. coli* K88 and F18 have been isolated, these deadly variants were found to be equipped with lethal heat stable, heat labile, verotoxin genes (Lin *et al.*, 2003). Different approaches that included addition of antibiotics in feed, vaccination against common post weaning diseases have failed to deliver desired results. On the contrary there has been

sharp increase in the occurrence of anti-microbial resistance in variety of pathogenic bacteria from pigs, including *E. coli* (Aarestrup, 2000). The potential for animal feed used antibiotics to contribute to the development of antibiotic-resistant bacteria of human concern is a matter seeking urgent attention (Aarestrup *et al.*, 2000). Intense debates and research in this subject are currently underway to find a way out. Sustainable veterinary medicine for animals that incorporates the best of traditional and Western veterinary medicine has been proposed as a best way out (Lin *et al.*, 2003). Herbal medicine has been in use for treatment and prevention of animal diseases since time immemorial and is fast claiming their hold in mainstream medication (Abelson, 1990). These natural remedies contain various compounds that have anti-bacterial, immunomodulant, antidiarrheal, appetizing effects on the piglets (Chang *et al.*, 1996 and 1997). There are numerous evidences of inclusion of herbal mixtures or single herb for enhancing growth in swine farming (Wheeler and Wilson, 1996; Lin *et al.*, 1997; Grela *et al.*, 1998; Wang *et al.*, 1998 and Mellor, 2000). Besides the herbs acupuncture (Lin., 1987), homeopathy (May *et al.*, 1997; Albrecht and Schutte, 1999) and other traditional techniques are adopted to control diarrhea in piglets and enhance their growth. In the same line we have tried to investigate the dried powder of *Sarcandra glabra* and its hot water extract as a growth promoter in weaned pigs. This evergreen herb (50 –150 cm tall) belonging to Chloranthaceae family is a popular component of Chinese and Ayurvedic medicine. Istanbulin, isofraxidin, fumaric acid (You and Cheng, 1997; Hu *et al.*, 1999 and Zhou *et al.*, 1999), sesquiterpene lactone (Wang *et al.*, 1988) are some of the pharmacologically active compounds in this herb. As a positive control levamisole an oral imidazole was used which apart from its anthelmintic activity is recognized and employed for its immunomodulatory activity. It is used as an adjunct with different antimicrobial drugs (Bozic *et al.*, 2002). Levamisole is a proven growth enhancer in post-weaning piglets (Kumar *et al.*, 1999). S. glabra was chosen because of its high reputation in Chinese herbal medicine. The investigation was undertaken to verify some unpublished reports and traditional claims about the potent growth promoting ability of the herb. Based on the findings of this experiment we confidently acknowledge the growth performance enhancing effect of *S. glabra* in post weaning pigs. It was also noticed that hot water extract of the herb was superior in performance over the dried powder of the same. The identity of main active compounds in the herb that contributes to the superior performance of pigs in the treatment group and their mechanism of action is a matter of further investigation.

Materials and Methods

Herb Preparation: The dried leaf of *Sarcandra glabra* (Thunberg) Nakai was powdered in an electric grinder and stored in a refrigerator prior to use. Hot water extract of the herb was prepared from the grind material by counter current extractor method. The condition of operations employed is as follows: (1) sampling time 10 min., (2) influx rate 0.1˜0.2 kg/min., (3) temperature 90 of water in extractor, (4) propeller speed of extractor 60 Hz., (5) spilling height of water level 21 cm., (6) increasing height of water level 11cm., (7) extracted solution concentration 7.63 ° Brix. The above solution was further prepared by sprayer-dried machine under 160 in chamber and 90 at efflux gate. The yield rate was 7.98% of proportional to total ingredient amount.

Animals and Design: Sixty piglets, Landrace (L), Yorkshire (Y) and hybrid (LY), were weaned at 28 days of age (average initial weight was ˜8.16 kg) and randomly allocated to four treatment groups according to RCB design. Each treatment had three pen/duplicates and 5 piglets in each. Four groups were tested concurrently, details of the treatments design are provided in Table 1 and 2.

Table 1: Treatments of feeding trial for the first 2 weeks (1-14 day) of the experimental period

Test group	No.of pigs	Description of treatments
Lot 1	5X3	Pre-starter basal diets without any additive
Lot 2	5X3	Basal diets + Levamisole 55 ppm
Lot 3	5X3	Basal diets + dried herb powder 0.4%
Lot 4	5X3	Basal diets + extracted herb powder 0.064%

Table 2: Treatments of feeding trial in second 2 weeks (15-28 day) of the experimental period

Test group	No.of pigs	Description of treatments
Lot 1	5X3	Starter basal diets without any additive
Lot 2	5X3	Basal diets + Levamisole 55 ppm
Lot 3	5X3	Basal diets + dried herb powder 0.05%
Lot 4	5X3	Basal diets + extracted herb powder 0.008%

Feed: The basal composition of the feed used as control group is shown in Table 3. The other three treatment groups received their addition as mentioned above. Fresh feed was prepared in small bulk mixing with the respective treatment additive was done thoroughly to ensure uniform distribution. Crude protein (CP) and digestible energy (DE) available in the two phases of feeds (pre-starter and starter) was calculated as 20.08, 20.00% and 3593, 3551 kcal kg^{-1}, respectively (Table 3).

Procedure: The experimental animals were housed in a post-weaning sty with woven wire floors, feed and fresh water was provided at *ad libitum*. High standard bio-security was adopted and provision was made to record any feed spillage. The piglets were fed with pre-starter diet (phase 1) from d 1 to 14 post-weaning and fed starter diet (phase 2) from d 15 to 28, respectively. The parameters measured were daily weight gain, daily feed intake, FCR, number of diarrheic piglets and the days of diarrhea persistence.

Statistical Analysis: Data in the trial were calculated by randomized complete block design (block as liter), using personal computer SAS (1988) of general linear model (GLM) procedure to analyze the variance. Treatment means were tested by Duncan's multiple range tests (DMRT) method. The pen was considered the unit for average daily gain, average daily intake and FCR. The formula employed for statistical evaluation is shown below:

Analyzed model for phrase 1:

$Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$

Y_{ij} = observation value (the I treatment and j block effect)

μ = average of the population

τ_i = the effect of the I treatment, (i = 1, 2, 3)

β_j = the effect of the j block, (j = 1, 2, 3)

ε_{ij} = the error of the I factor and the j block

Analyzed model for phrase 2:

$Y_i = \mu + \tau_i + \varepsilon_i$

Y_i = observation value (the I treatment and j block effect)

μ = average of population

τ_i = the effect of the I treatment, (i = 1, 2, 3)

ε_i = the error of the i factor

Table 3: Composition of experimental basal diets for baby pigs

Item	Pre-starter	Starter
Ingredients (% as fed basis)		
Extruded corn, yellow	25.00	---
Corn, yellow	17.542	42.15
Dry skim milk	10.00	---
Dry whey	15.00	18.0
Soybean meal, solvent (CP 43.5%)	21.80	33.0
Fish meal (CP 65%)	3.00	---
Tallow	4.00	4.0
Di-calcium phosphate	1.00	1.4
Limestone	0.35	0.4
Common salt	0.30	0.3
Fumaric acid	1.00	---
Vitamin mix[a]	0.30	0.30
Mineral mix[b]	0.15	0.15
Lysine-HCl	0.20	0.10
DL-Methionine	0.05	0.05
Choline chloride(50%)	0.10	0.10
Enzyme	0.02	0.05
Flavor	0.003	---
ASP-500	0.185	---
Calculated nutrient composition		
Crude protein, %	20.08	20.00
Crude fat, %	6.09	6.05
Crude fiber, %	2.59	3.49
Calcium, %	0.86	0.80
Phosphorus, %	0.72	0.70
Digestible energy, Kcal kg^{-1}	3.593	3.551

[a] Vitamin added per kg feeds:
Pre-starter and starter : vit. A 21,000 IU, vit. D_3 1,800 IU, vit. B_1 3.0 mg, vit. B_2 9.0 mg, vit. B_6 3.0 mg, vit. E 60.0 mg, vit. K_3 2.4 mg, pantothenic acid 15.0 mg, niacin 34 mg, folic acid 1.5 mg, choline 350 mg, vit. B_{12} 60 ug, biotin 0.18 mg

[b] Mineral added per kg feeds:
Pre-starter and starter: Cu 134mg, Fe 54 mg, Zn 108 mg, Mn 32 mg, I 1 mg, Co 1 mg, Se 0.1 mg.

Results and Discussion

The results of four weeks of experimental period (Table 4), showed that there was a highly significant difference ($p<0.01$) on the daily weight gain between the fourth group and the rest (0.503 vs 0.441, 0.443, 0.443 kg, respectively). There was also a highly significant difference ($p<0.01$) in the daily feed intake between the fourth group and the control and third group (0.795 vs 0.701, 0.675 kg, respectively). There was significant difference in the FCR, the third and fourth treatment group had significantly lower ratio compared to the first and second. No significant difference was noticed among the different groups in relation to the incidence of diarrhea during four weeks of experimentation period. The findings imply the possible addition of *S. glabra* in the list of possible alternatives to antimicrobial and synthetic growth promoters in post-weaning pigs.

New era of animal farming is being challenged by the quest for safe food devoid of chemical residues and anti-microbial resistant pathogens. There is a desperate search for drugs that will treat infectious diseases without incurring the ecological side effects common to antibiotics, that of killing normal flora and selecting resistant pathogens (Heinemann, 2001). This has highlighted the importance of alternatives to antibiotics use for growth promotion in animal husbandry (Lin *et al.*, 2003). At present the estimated use of antibiotics in animal agriculture is 7.36-11.18 million kg year^{-1}, many fold more than in human use (Doyle, 2001).

Misuse of antibiotics both for medical and veterinary purpose have resulted in the appearance of resistant strains of bacteria. The benefits of sub-therapeutic use of antibiotics is not only limited to control of pathogenic microorganism but enhanced metabolic process and better feed utilization. This is an easy but unsustainable way to compensate for the compromised bio-security of the animal's environment. As misuse of antibiotics comes under stricter regulatory vigilance farmers are turning their attention to improve hygiene, sanitary and other husbandry practices. There are subsidies to encourage organic farming as an example the Netherlands government had recently begun to provide subsidy of 30% to organic pig production. On the other hand in poor countries of the world where livestock is seen as a way to eliminate poverty the need to employ cheap locally available resources is very crucial.

One way out has been the use of immune stimulatory agents and natural sources of medicines like herbal extracts. Levamisole has been employed as a safe addition in animals feed both in swine and poultry farming. However being a synthetic drug and unpalatable due to its bitter taste added to the high cost makes it unsuitable for regular use. Besides it is associated with side effects that can set up with long term use. Although there are alternative agents in development but they are few in number and the rationale for their development is not broadly understood. The effort to develop alternative concept to antimicrobial agents has been disappointing and fewer technologies and

Table 4: Performance of weaning pigs fed diets with different type of herbs

Item	Control	+Levamosole	Dried herb powder	Extracted herb powder	SEM	p value
No. of pigs	5 x 3	5 x 3	5 x 3	5 x 3		
Avg. initial body wt, kg	8.31	7.69	8.17	8.46		
Final wt., kg	21.12	21.09	20.77	22.43		
Daily feed intake, kg						
1-14d	0.441^{ab}	0.405^{ab}	0.369^{b}	0.443^{a}	0.014	0.0468
15-28 d	0.972^{b}	1.027^{ab}	0.978^{b}	1.099^{a}	0.031	0.0777
1-28 d	0.701^{b}	0.715^{ab}	0.675^{b}	0.795^{a}	0.021	0.0604
Daily gain, kg						
1-14 d	0.293^{A}	0.234^{B}	0.231^{B}	0.324^{A}	0.010	0.0019
15-28 d	0.578^{cC}	0.628^{bAB}	0.623^{bBC}	0.662^{aA}	0.009	0.0016
1-28 d	0.441^{B}	0.443^{B}	0.443^{B}	0.503^{A}	0.009	0.0035
Feed conversion ratio						
1-14d	1.403^{bB}	1.736^{aA}	1.601^{aAB}	1.384^{bB}	0.042	0.0029
15-28 d	1.678	1.648	1.568	1.633	0.049	0.4975
1-28 d	1.587^{A}	1.613^{A}	1.558^{B}	1.548^{B}	0.044	0.7183
Diarrhea situation						
head	13	10	13	11		
days	30	28	28	25		

Different superscript letters within a column are significantly different ($p<0.05$). Different capital letters superscript within a column are highly significantly different ($p<0.01$)

proven alternatives are available for use. Some commercial herbal products are in use in South Asia and elsewhere e.g. Neblon (Indian Herbs), Diaroak (Dabur Ayurvet) which are brand leaders in the category of anti-diarrheals. Neblon (Nebusi) is a complex formula of herbs such as *Acacia catechu*, *Woodfordia fructicosa*, *Tinospora cordifolia*, *Berberis aristata*, *Aegle mermelos*, *Symplocos paniculata*, *Salmalia malabarica*, *Zingiber* and *Polygonum viviparum*. Experiment with the product (Neblon) in UK reported enhanced overall growth performance in pigs, 16% reduction in FCR, 13% less mortality compared over the control group (Wilson *et al.*, 2003). The first challenge in encouraging the use of herbal alternatives is to provide scientific evidences which are found lacking.

In quest for a natural growth promoter for use in post-weaning piglets and to add up to existing knowledge we undertook this experimentation task. The herb powder and its hot water extract were used as the experimenting material over the control and levamisole treatment as positive group. Overall performance of hot water extracted powder of *S. glabra* was found to be superior to potency then that of the complete herb powder. These results have shown that *S. glabra* extract acts as an appetizer and a growth promoter in weaned pigs. The results also indicate the presence of active compound in water extracted part of the herb which can significantly reduce the amount of herb that can actually be added in the feed. The identity of pharmacologically active compound in the herb and its mechanism of action in achieving overall growth performance activity remain to be further investigated.

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