

# EFFECTS OF WINE LEES AS SUPPLEMENTAL FEED ON THE MICROFLORA, MEAT PRODUCTIVITY AND MEAT QUALITY OF FATTENING PIG

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**Abstract** — In a previous study, we found that the feed intake of birds increased when sweet potato litters were added to their diet, and that the nutritional quality of the meat of pigs fed sweet potato litters increased, particularly the level of vitamin E content of their meat, which increased significantly in the fat tissues. The purpose of this study was to determine whether wine lees could be used as functional forage for pigs. This study investigated the effects of these litters on fattening pigs, in terms of the physiochemical properties and microflora of their faeces, growth condition, meat productivity and the nutritional quality of their meat. Adding to our previous findings concerning the use of by-products as animal forage, this study provides evidence that wine lees may also have potential for use in animal nutrition. The data on vitamin E content suggest that the nutritional value of wine lees is good and so they could be utilized as functional feed in animal diets. The nitrogen content in faeces was reduced, which indicates that the digestive systems of animal acclimatized to the diet and the absorption rate of nutrients was improved. Most importantly, noxious bacteria were not detected in animals' faeces. This research may also provide adequate evidence that meat quality was improved and that some physiological functions of the feed constituents have been elucidated, and it is important to use such feed for the maintenance and promotion of animal health.

**Keywords:**—animal diet, fattening pigs, meat quality, wine lees.

## I. Introduction

The use of natural materials such as wine lees as supplemental feed may prove to be ideal. Recently, the use of by-products in feed is a concern of many researchers throughout the world, particularly in Japan. In generally, Miyazaki prefecture, located on the island of Kyushu in the southern part of Japan, wine is produced in at three places, many by-products and remnants of grapes are discarded without benefit during wine production. In previous studies, we have determined the effectiveness of introducing the litters and the leaves of sweet potatoes to the diet of egg-laying hens. We found that when the amount of sweet potato litters in their diet was increased, the feed intake of the birds increased (Takenoyama et al., 2007). Furthermore, we found that the nutritional quality of the meat of pigs fed sweet potato litters improved, particularly the level of vitamin E content of the meat, which increased significantly in the fat tissues (Takenoyama et al., 2008). These data suggested that this kind of forage may also have significant effects on the productivity of meat animals such as pigs and beef cattle. The purpose of this study was to determine whether wine lees could be used as functional forage for pigs. This study investigated the effects of these litters on the physiochemical properties, odor and microflora of faeces, growth condition of the pigs, meat productivity, the nutritional quality and nutritional properties of their meat. Meat quality, in this context, included lipid content, vitamin E content and fatty acid compositions.

## II. Materials and Methods

The subjects of this experiment were pigs of a new generation from ternary cross- breeding (Large White × Landrace × Duroc). The pigs were divided into two groups based on diet type. The control group was fed an ordinary diet, while the experimental group was fed an ordinary diet supplemented by dried lees of white wine (chardonnay) (5%). All of the seeds, skins, pulp and stems of the grapes, which had been left behind after the first pressing of wine were added to the diet when the animals weighed 60kg each and this feeding diet was completed when those animals had gained 110kg. The animals were raised in normal environmental conditions at a pigsty in the Miyazaki Livestock Research Center. The animals were subjected to weight gain tests and body size determination before being slaughtered. We collected excrement and urine from the pigs in week 0 and week 3 (the fattening period), the physiochemical properties (moisture, organic matter, ash, pH), odor and microflora of faeces collected from fattening pigs were investigated. We examined the growth performance of the animals (including fattening days, daily weight gain, feed intake and feed demand rate). Then, the animals were slaughtered in a local slaughter house and were measured for their meat productivity. Thereafter, all of the postmortem pigs were subjected to further tests such as carcass traits (carcass weight, carcass yield and back fat thickness). The meat quality was determined and nutrient contents were measured. Vitamin E content was determined by the method of Yamauchi et al., (1980). Lipid content and fatty acid compositions were also examined as we described in a previous publication (Takenoyama et al., 1999). In addition, heating loss and toughness of the meat were also measured.

### III. Results and Discussion

The moisture of the faeces was determined at 3 weeks and it was significantly increased in the test group ( $P<0.05$ ), which perhaps reduces the possibility of animal constipation. The diet containing 5% wine lees had no effect on the levels of organic matter, pH, electric conductivity (EC) and odor of animal faeces (Table 1). Yet, there was an insignificant decrease in ash content of the faeces, which indicates that the nutrient absorption rate in those animals was improved.

**Table 1.** Effects of wine lees as supplemental feed on the physiochemical properties of faeces of fattening pigs at 3 weeks.

Sample	Moisture (%)	Organic Matter (%)	Ash (%)	pH	EC
Control (n=5)	56±2.8	86±3.0	14±3.0	6.42±0.23	1.29±0.11
Test (n=5)	61±1.0	89±1.1	11±1.1	6.28±0.30	1.51±0.35

The ammonia levels of the urine of the experimental group were reduced significantly at 3 weeks ( $P<0.05$ ) and were insignificantly at 5 weeks. In addition, the nitrogen contents in the excrement of the experimental group at 3 weeks and before slaughter were also insignificantly lower than in the control group. In addition, the level of ammoniain the blood at 3 weeks were also significantly lower than those in the control group ( $P<0.05$ ). This suggests that the protein in the diet was digested properly and absorbed by the pigs and that their nutrient intake was improved (Table 2). This suggests that when mixing wine lees with the basal diet increases the functional roles of the digestive systems of the animals. This would contribute considerably to the meat quality of animals bred in pens.

**Table 2.** Effects of wine lees as supplemental feed on the level of ammonia excrement and blood of fattening pigs at 3 weeks.

Sample	Ammonia Level in Urine	Volatile Nitrogen in Excrement	Ammonia Level in Blood
Control (n=5)	7495±1092	124±58	168±35
Test (n=5)	5348±1026	122±28	135±24

\*This value shows mg / kg of samples.

The effects on microbial content of adding by-products left over from wine production to pig diet were measured. The noxious bacteria of *Clostridium Perfringens* and *Salmonella* were not detected as the wine contains considerable amounts of polyphenols. Though the *Lactobacillus* and *Bifidobacterium* contents did not change in this experiment, the *Enterobacteriaceae* contents was slightly decreased before slaughtering of the experimental group was (Table 3). These results suggest that microflora populations in the faece of fattening pigs were impacted by the addition of wine lees, and that the polyphenol of the wine by-products influenced. Most importantly, noxious bacteria were not detected.

**Table 3.** Effects of wine lees as supplemental feed on the microbial content (log CFU/g) of Enterobacteriaceae of excrement of fattening pigs.

Week 0	<i>Entero-bacteriaceae</i>	<i>Clostridium Perfringens</i>	<i>Salmonella</i>	<i>Lactobacillus</i>	<i>Bifido-bacterium</i>	Total Bacteria
Control (n=8)	6.22±0.62	N.D.	N.D.	8.57±0.21	7.98±0.60	9.85±0.08
Test (n=8)	6.25±0.72	N.D.	N.D.	8.73±0.33	8.35±0.44	9.96±0.24
Before Slaughter	<i>Entero-bacteriaceae</i>	<i>Clostridium Perfringens</i>	<i>Salmonella</i>	<i>Lactobacillus</i>	<i>Bifido-bacterium</i>	Total Bacteria
Control (n=8)	4.79±1.04	N.D.	N.D.	8.58±0.24	7.87±0.30	9.66±0.15
Test (n=8)	4.47±0.64	N.D.	N.D.	8.64±0.14	7.86±0.34	9.77±0.11

As a result of supplying the wine lees to the fattening pigs, daily gain and feed intake did not change between the two groups, but the feed demand of the experimental group were reduced insignificantly (table 4). This suggests that the palatability of diet containing wine lees is acceptable. The observation that palatability is associated with greater food intake is well documented in studies on animal subjects. Palatability is the word used to describe how well an animal likes the flavor, aroma and texture of a food.

**Table 4.** Effects of wine lees as supplemental feed on growth condition of fattening pigs.

Sample	Daily Gain (kg/day)	Feed Intake (kg)	Feed Demand*
Control (n=8)	1.041±0.121	3.876	3.72
Test (n=8)	1.049±0.133	3.795	3.62

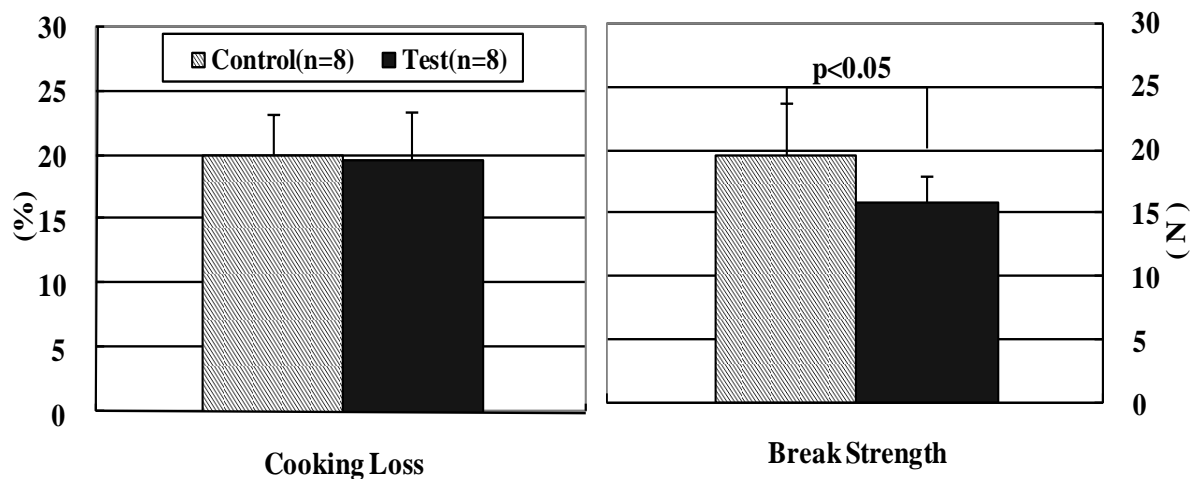
\*This value shows the demand rate of the commercial basal diet.

The diet containing wine lees had no impact on the carcass weight, carcass yield or back fat thickness, and so there was no significant difference in meat productivity compared with the control group (table 5). Feeding with the diet containing wine lees result in good growth condition and meat productivity of fattening pigs which were equivalent to those fed the basal diet. Thus, a diet containing wine lees was found to be useful as a fattening diet for pigs.

**Table 5.** Effects of wine leed as supplemental feed on meat productivity of fattening pigs.

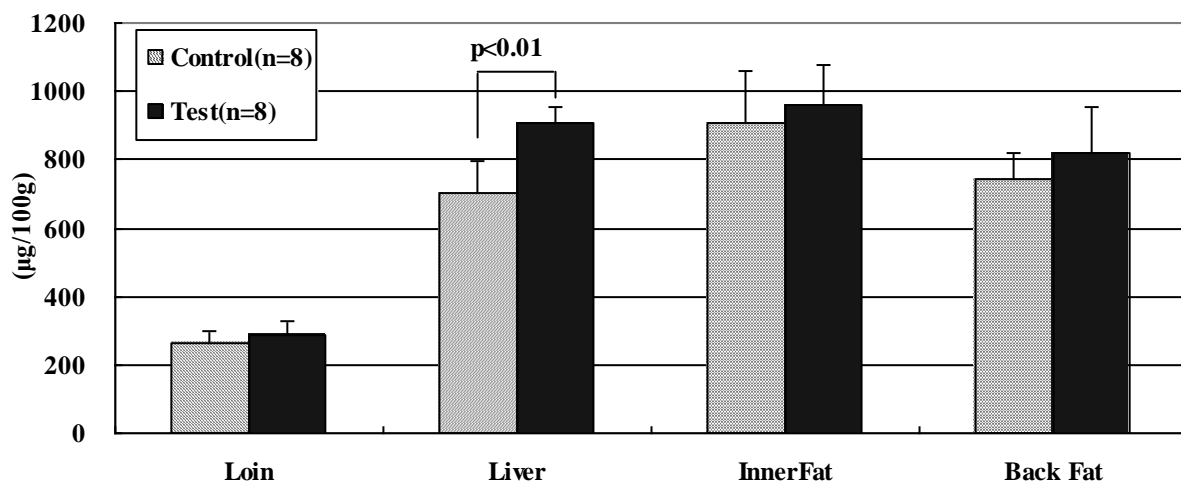
Sample	CarcassWeight (kg)	Carcass Yield (%)	Back Fat Thickness (mm)
Control (n=8)	71.9±7.6	64.4±1.6	20.3±6.5
Test (n=8)	70.5±7.2	63.0±1.4	17.4±4.7

There were no remarkable difference in cooking loss at loin between fattening pigs fed the wine lees and basal diets (Figure 1). However, break strength of the cooked loin meat from the test group showed a significantly lower value ( $p<0.05$ ) when compared with the control group. Therefore, the diet containing wine lees was effective in improving meat quality, suggesting the possibility of producing characteristically tender meat.



**Figure 1.** Effects of wine lees on cooking loss and break strength of loin from fattening pigs.

When measuring the effects of the wine lees feeding on nutritional properties in different cuts, the lipid content and free amino acids of the test group and control group did not vary significantly (data not shown). Vitamin E content in the loin meat and fat tissues insignificantly increased in the test group, but it was significantly increased in liver tissue ( $P < 0.01$ ) (Figure 2). The results suggest that the wine lees diet is a good tool in improving some nutritional profiles, especially vitamin E. In this regard, the results of this research encourage the use of agricultural industry by-products in the fields of animal nutrition.



**Figure 2.** Effects of wine lees on vitamin E contents in loin, liver and fat tissues in fattening pigs.

#### IV. Conclusions

The studies reported herein were initiated to determine the value of feedind white wine lees to pigs during the growing-fattening period, and also to determine the feasibility of using as supplemental feed. The work was also designed to determine the effects of those additives on the growth performance, meat productivity, and the quality and nutritional properties of the meats of fattening pigs. The meat of the group fed the diet conatining 5% wine lees was nutritionally improved, particularly in the level of vitamin E content of the meat, which was increased significantly in the liver tissues. This study suggests that wine lees may serve several nutritional purposes. Based on these remarkable results, we suggest that wine lees be used as a forage additive, and that they may have potential applications as a functional feed. The feasibility of this study was in utilizing wine lees as forage for pigs generated from ternary cross breeding, and ecological benefits from using materials that would otherwise be discarded. Therefore, we encourage swineherds to utilize this kind of forage instead of other expensive imported ingredients.

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