

Feeding practices for wild pigs to develop pork processing as value addition in northern region of Vietnam

B.T. Thom¹, D.T.N. Huy^{2*}, B.T. Suu³, N.T. Hoa⁴, D.T. Hien⁵

¹Thai Nguyen University of Agriculture and Forestry; ²Banking University HCMC, Ho Chi Minh city; ³Tay Bac University, Quyet Tam Ward, Son La City, Son La Province; ⁴Thu Dau Mot University, Binh Duong; ⁵Thai Nguyen University of Sciences, Thai Nguyen Vietnam

*Corresponding author e-mail- dtnhuy2010@gmail.com

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Abstract

It is the time we need to explore livestock value chain in wild pigs and wild pork in the Northern region of Vietnam. Thom, B.T., & Huy, D.T.N (2021) stated At present, most pig breeds are selected and raised in accordance with local conditions, especially wild boar and hybrids are very popular with people, the demand for products is increasing day by day. In this paper, the research team selected a selective sampling survey method with a non-random manner with the determination of the sample size in accordance with the data analysis method. It used qualitative analysis with synthesis, inductive methods, references and experience from experts. The results showed that for commercial wild boar farming, the diet has a protein level of 16-14% and a metabolic energy level of 3000-2900 kcal/kg of feed in the diet for growth and fattening stages respectively is the most reasonable, both capable of growth of hybrid wild boar and economically viable in breeding conditions by semi-wild method in ecological conditions of Thai Nguyen. Beside, in recent years, under covid 19 effects, the concept of cycled economy is important to maintain high rate of employment and help the economic growth. Therefore, every stages in wild pigs and pork cycle from input to production and distribution to market need to be in a cycle and can be supported by big corporations.

Key words: wild pigs; pork; cycled economic value chain; livestock sector; Northern region; Vietnam

Introduction

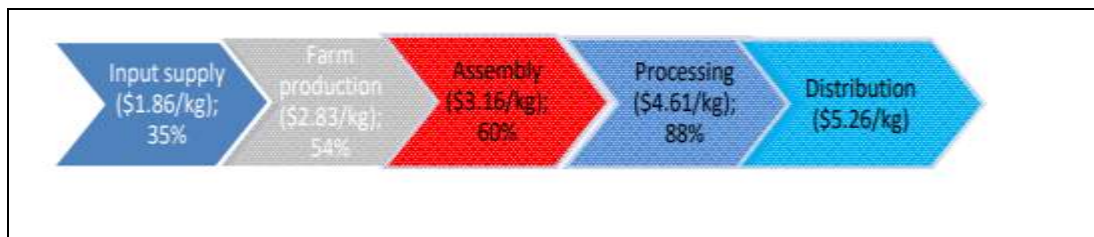
Pig farming is very important in Vietnam, especially in Thai Nguyen city and Northern provinces (Thom et al 2021). Pork products are suitable for people's taste. The results of several studies in this regard are summarized a below,

Table 1 – Summary of previous studies

Authors	Contents, results
Simons et al 2008	Value Chain Analysis (VCA) is a tool for analysing the nature and source of value within a supply chain and the potential for reducing waste therein, with the focus explicitly on the determinants of value within a manufacturing process rather than the simple measurement of process outputs. The tool has been successfully applied in recent years within the motor and information technology industries, to assist forward thinking businesses to survive in an increasingly competitive environment.
Thom & Huy, 2021	Feeding wild pigs and managing wild pork meat quality is meaningful in Vietnam, esp. In Thai Nguyen province as pork products can offer variety of tastes due to food processing and suitable for Vietnamese tastes and can export to the world widely
Ehlers and Anders 2017	checked the state of pork supply as to its neglect of developing innovations and mechanisms for delivering superior eating quality to consumers. We explore reasons behind pork supply chains' predominant focus on mass production combined with traceability and food safety
Yuzaria et al 2020	the value chains involved in i-Ternak as a website manager are investors, suppliers, breeders and processors and distributors of cattle and meat. The margin obtained is still low as investors get 7.76% per 6 months, the biggest chain with margins is meat processed while the lowest is livestock.
Thom et al 2021	For commercial cross-bred wild boar farming, a diet with a protein level of 16-14% and a metabolic energy level of 3000-2900 kcal/kg of feed in the diet for growth and fattening most appropriate

Djanza et al (2013) mentioned beef value chain in Malawi as follows:

Figure 1- Beef value chain from farm-gate to distribution



In a long time, value chain analysis became an effective tool in many industries including livestock sector, that's why in this study scope of wild pigs we come back to value chain concept to enhance value for Vietnam livestock sector.

The present study was taken up to provide data on appropriate crude protein and energy levels for F2 wild boars; to generate research materials on nutritional feed for pigs; to develop supplementary materials in teaching and studying students, training for breeders, contributing to the development of hybrid wild boar breeding in the Northern area of Vietnam. It was aimed to provide answer to following questions,

- (i) What are factors affecting nutrition food mechanism for wild board?
- (ii) What factors affecting pork meat quality?
- (iii) What are value chain concepts in wild pigs and pork?

Methodology

Method and Data

The research team selected a selective sampling survey method with a non-random manner with the determination of the sample size in accordance with the data analysis method. This study also used Experimental set-up method, under references and experience from experts. Author also use qualitative analysis with synthesis, inductive methods. Duration of study was approximately 8 months.

These wild pigs are fed in Thai Nguyen Farms. The meat was analyzed for crude protein, crude lipids, total minerals, dry matter, pH value, pH 45 minutes after slaughter, toughness, color and blood collection to check the content of Cholesterol, Triglyceride on BT 1500 device and automatic counter of the Hospital of Thai Nguyen University of Medicine and Pharmacy. The method of determining the quality of feed, the quality of experimental pork is calculated on the equipment system of the Institute of Life Sciences, Thai Nguyen University based on Vietnamese standards.

The cost of feed / kg of weight gain was analysed as

Feed cost/ 1 kg increase in volume (VND) = Feed consumed (kg) cost of 1kg of feed (VND)/ Σ weight gain in the experiment period (kg)

Table 2 - Feed consumption/day of experimental pigs (kg/head/day)

Stages of experiment	Lot TN1		Lot TN2		Lot TN3	
	Core food	Green food	Core food	Green food	Core food	Green food
Begin -1 month	0.25	0.51	0.21	0.49	0.19	0.46
02-Month1	0.37	0.79	0.39	0.75	0.35	0.71
03-Month 2	0.53	1.22	0.55	1.20	0.52	1.18
04-Month 3	0.65	1.44	0.61	1.51	0.66	1.43
Average stage 1	0.45	0.99	0.44	0.99	0.43	0.95
Compare (%)	100	100	97.78	100	95.56	95.45
05-Month 4	0.76	1.73	0.73	1.72	0.80	1.80
06-Month 5	0.95	2.10	0.92	2.00	1.11	2.25
07-Month 6	1.11	2.45	1.04	2.55	1.07	2.56
08-Month 7	1.21	2.99	1.23	2.79	1.22	3.04
Average stage 2	1.01	2.32	0.98	2.27	1.05	2.41
Compare (%)	100	100	97.27	97.73	104.22	104.10
Overall mean	0.73	1.65	0.71	1.63	0.74	1.68
Compare (%)	100	100	97.43	98.34	101.54	101.51

(source: Thai Nguyen University of Agriculture and Forestry, Wild pigs project, Bui Thi Thom, 2013)

The cost of feeding wild pigs was as below:

Cost to buy breeding stock wild boar: 500 m VND

Cost of building barn: 200 m VND

Feed cost: including feed for wild boar parents and piglets born from broodstock: 225 m VND

Electricity and water costs: 15 m VND/year

Labor cost (2 people): 100 m VND

Total cost in 1 year = 10,000,000 (barn) + 225,000,000 (food) + 15,000,000 (electricity, water) + 100,000,000 (labor) = 350,000,000 VND.

(source: <https://nongnghiep.farmvina.com/nuoi-lon-rung/#BN-1f901905cb5a0599>, access date 10/9/2021).

The sale price of products was as below:

Type 1: 180,000 VND/1kg steam.

Type F2: 170,000 VND / 1 kg of steam.

Commercial wild boar type 1: One pore with 3 pores, stiff hair, 1cm thick inner skin, little fat.

Commercial wild boar type 2: 1 hole 3 pores, soft hair, 0.5cm thick opaque skin, little fat.

(source: TNC wild pig farm. <https://www.lonrung.com/gia-lon-rung>, acces date 10/9/2021).

Results

We recognize that (see table 3) the main food material with highest ratio include Red kernel, bran and soybean meal. And total protein contains highest in food .

Feeding wild pigs

Table 3- Experimental diet of wild boar F2 (first time) (Growth stage)

Food material	Food price /kg	Lot TN 1 (17%)		Lot TN 2 (16%)		Lot TN 3 (15%)	
		Ratio (%)	Value (VND)	Ratio (%)	Value (VND)	Ratio (%)	Value (VND)
Red kernel corn	7,200	55.00	3,960	56.00	4,032	53.00	3,816
Bran	8,000	20.00	1,600	21.00	1,680	24.00	1,920
Soybean meal	16,200	18.00	2,916	16.00	2,592	15.50	2,511
Fish meal grade I	23,000	3	690	3	690	3	690
Vegetable oil	12,500	3	375	3	375	3	375
Salt	2,000	0.14	3	0.14	3	0.14	3
Lime	600	1.13	7	1.13	7	1.13	7
Green food (elephant grass, banana stem)	500		Free eat		Free eat		Free eat
Total		100	9,551	100	9,379	100	9,322
1 kg food has							
Metabolic energy(Kcal)	3000						
Total Protein (gam)	170			160		150	
Canxi (gam)	10			10		10	
Photpho (gam)	8			8		8	

(source: Thai Nguyen University of Agriculture and Forestry, Wild pigs project, Bui Thi Thom, 2013)

Table 4- Experimental diet of wild boar F2 (first time) (fattening phase)

Food material	Food price /kg	Lot TN 1		Lot TN 2		Lot TN 3	
		Ratio (%)	Value (VND)	Ratio (%)	Value (VND)	Ratio (%)	Value (VND)
Red kernel corn	7,200	57	4,104	56	4,032	52	3,744
Bran	8,000	22	1,760	19	1,520	27	2,160
Soybean meal	16,200	12.74	2,064	12.4	2,009	12.32	1,996
Fish meal grade I	23,000	2.03	467	2.2	506	1.95	449
Vegetable oil	12,500	5	625	5	625	5	625
Salt	2,000	0.2	4	0.14	3	0.14	3
Lime	600	1.03	6	1.06	6	1.09	7
Green food (elephant grass, banana stem)	500		Free eat		Free eat		Free eat
Total		100	9,030	96	8,701	100	8,983
1 kg food has							
Metabolic energy(Kcal)	3000						
Total Protein (gam)	150			140		130	
Canxi (gam)	10			10		10	
Photpho (gam)	8			8		8	

(source: Thai Nguyen University of Agriculture and Forestry, Wild pigs project, Bui Thi Thom, 2013)

Table 5- Ingredients of experimental feed for F2 .hybrid wild boar (Growth stage) (2nd time)

Food material	Food price /kg	Lot TN 1		Lot TN 2	
		Ratio (%)	Value (VND)	Ratio (%)	Value (VND)
Red kernel corn	7.500	57.00	4.275	57.00	4.275
Bran	7.200	23.21	1.671	24.20	1.742
Soybean meal	16.500	13.20	2.178	12.23	2.018
Fish meal grade I	23.000	2.5	575	2.5	575
Vegetable oil	12.500	2.8	350	2.8	350
Salt	2.000	0.15	3	0.14	3
Lime	500	1.14	6	1.13	6
Green food (elephant grass, banana stem)	1.000		Free eat		Free eat
Total		100.00	9.057.82	100.00	8.968.80
1 kg food has					
Metabolic energy (Kcal)		3000		2900	
Total Protein (gam)		160		160	
Canxi (gam)		10		10	
Photpho (gam)		8		8	

(source: Thai Nguyen University of Agriculture and Forestry, Wild pigs project, Bui Thi Thom, 2013)

Hence, we see that bran and soybean meal covered with higher ratio (in table 5) compared to their ratio (in table 4). Effect of nutritional composition in the diet: Dietary composition from a modern point of view is the general balance in terms of quantity and quality of nutrients such as protein, amino acids, minerals, vitamins, and starch. flour, fat with an appropriate ratio to ensure high digestibility and feed efficiency, in which the appropriate protein ratio will contribute to feed costs, reduce costs and improve productivity. In the balance relationships between nutritional components, people are most often interested in the protein/Exchange energy (energy) relationship; amino acids/energy, maximum fiber content. The nutritional balance in the diet was developed for pig subjects and incorporated into the dietary standards.

A regular problem is that in the adult body, there is generally no accumulation of protein, but only the renewal of protein according to the principle of keeping nitrogen balance. But in growing pigs, if the diet only provides enough protein for maintenance, increasing the percentage of dietary protein will lead to an increase in protein digestibility to establish a positive nitrogen balance at a gradually higher level. However, when the protein supply is too high compared to the accumulated demand (protein excess), the amount of nitrogen excreted will increase and the nitrogen balance is established at a high level, conversely, when the amount of protein decreases, it is lower than that with the need for protein accumulation, the nitrogen balance is again established at a lower level. From that, it can be seen that, in the condition that the diet meets sufficient protein quality, the arrangement of diets with reduced protein levels inevitably leads to an increase in the digestibility and utilization efficiency of dietary protein and a decrease in nitrogen content discharged. On the contrary, a diet with a high percentage of protein, not only reduces the rate of digestion and absorption of protein, but also increases the burden on the digestive organs, liver, and kidneys, and also wastes protein as well as increases pollution.

Not only the protein level, but the energy/protein or energy/amino acid relationship in the diet also affects the animal's feed utilization. This relationship is expressed in grams of protein or, more specifically, as grams of amino acids/1000 Kcal ME. These nutritional relationships have also been standardized to ensure the energy requirements for protein synthesis and storage in lean meat. If there is a lack of energy, it will lead to the body having to mobilize protein for energy, causing unnecessary waste.

One of the effects of nutritional composition on the digestibility of protein and amino acids in the diet is the balance between amino acids in the ingested protein. If the feed has a reasonable ratio between amino acids, it will reduce the protein requirements of pigs. Diets containing adequate and balanced essential amino acids, suitable to the needs of growing pigs at each growth stage, will be the basis of a reasonable reduction in total protein in the diet in order to save money and save protein food.



Figure 1 - Wild pigs in Vietnam (source: internet)

Survey results on yield and quality of experimental pork

Survey results

The survey at the end of the experiment is an important indicator of meat quality and whether it meets consumer demand or not.

Table 6- Results of slaughtering and yielding experimental pork

No.	Describe	Lot TN1	Lot TN2	Lot TN 3
		$\bar{X} \pm m \bar{x}$	$\bar{X} \pm m \bar{x}$	$\bar{X} \pm m \bar{x}$
1	Live weight (kg)	31.00 ± 2.45	31.50 ± 2.16	30.20 ± 1.98
2	Meat cut quantity(kg)	21.26 ± 2.10	21.62 ± 2.15	20.61 ± 2.78
3	Hook rate (%)	78.42 ± 0.19	78.85 ± 0.43	78.51 ± 0.78
4	Carcass percentage (%)	68.57 ± 1.26	68.65 ± 2.09	68.25 ± 2.12
5	Lean meat percentage (%)	56.85a ± 0.81	55.65a ± 1.11	54.89a ± 0.98
6	Fat percentage (%)	14.06 ± 0.76	14.36 ± 0.45	14.69 ± 1.05

(source: Thai Nguyen University of Agriculture and Forestry, Wild pigs project, Thom, 2013)

The survey results are presented in Table 6, showing that: The percentage of carcass meat in 3 experimental groups did not differ significantly (68.57 - 68.65 - 68.25%). For meat pigs, the percentage of lean meat is the most important and valuable criterion in carcass carcasses. The higher the percentage of lean meat, the higher the quality of the carcass, and the higher the selling price of pork. Among the 3 experimental groups, the lean percentage was highest in TN1 group (56.85%), TN2 and TN3 groups were 55.65% and 54.89%, respectively. However, the results of Table 4.7 show that in the experimental groups, with the same results of the experimental pigs, the lean percentage in the experimental groups with a high percentage of protein has a higher percentage of lean meat. but the percentage of fat tends to increase. However, the difference was not significant, not statistically significant ($P > 0.05$). In this experiment, the lean percentage was higher than that of Nguyen Ngoc Phuc et al. (2010) at 43.36 (Khua Pig) and 47.36% F1 crossbreed (Wild Boar x Khua). Meanwhile, the Tapa pig in Cao Bang is 32.9% (Trung et al. (2010); Soc pig in Quang Tri, the lean percentage is 43.2%.

The percentage of fat in the experimental plots reached from 14.06 to 14.69 %, the lowest in TN1 (14.06 %) and the highest in TN3 (14.69 %). Comparing the study of Phuc et al. (2010) in Khua pigs and F1 hybrids (wild boars x Khua) at the end of the growth period at 21.62% - 17.07%, respectively. our experiment lower fat percentage. The experimental results of F2 hybrid wild boar had the same proportion of carcass and jaw hook as that of Muong Khuong pig (the ratio of jaw hooking was 73.50-78.62%, the carcass rate was 64.08 - 69.83). %) but the percentage of lean meat was higher than that of the brackish Muong Khuong (39.89 – 46.41 %) when slaughtered at 10 months of age (Le Dinh Cuong (2008).

The above analysis shows that increasing and decreasing the amount of protein in the diet has an effect on the percentage of lean and fat in the experimental groups. This is the initial basis for building a reasonable diet for F2 hybrid wild boar.

Results of evaluating the quality of experimental pork

In addition, the experiment also assessed meat quality through a number of criteria presented in Table 7.

Table 7- Results of evaluating the quality of experimental pork

Describe	Lot TN1	Lot TN2	Lot TN3
	$\bar{X} \pm m\bar{x}$	$\bar{X} \pm m\bar{x}$	$\bar{X} \pm m\bar{x}$
Meat color after cut(Minolta L*) (brightness)	48.02 ± 1.11	47.95 ± 1.54	47.83 ± 1.36
Meat toughness (kg/ cm2)	4.85 ± 1.23	4.89 ± 1.56	4.95 ± 1.25
pH of tenderloin right after cutting meat	6.8 ± 0.32	7.0 ± 0.12	7.1 ± 0.15
pH thánhtisau 45 phút	5.5 ± 0.21	5.3 ± 0.24	5.2 ± 0.26
Cholesterol (mmol/L) blood	1.65 ± 1.23	2.15 ± 0.91	3.11 ± 1.89
Triglycerid (mmol/L) blood	2.3 ± 1.34	2.8 ± 0.98	2.6 ± 1.12

(source: Thai Nguyen University of Agriculture and Forestry, Wild pigs project, Bui Thi Thom, 2013)

Table 7 shows: The color of tenderloin of wild boar in the experiment fluctuated the average value of color index Minolta L* (brightness) from 47.83 ; 47.95; 48.02 and has a bright red color. The results were similar between the experimental groups, but the batch with a high percentage of protein tended to have higher color values, but the difference was not significant. Research by Ton et al. (2012) L* values are 43.08 – 46.88. Research by author Townsend et al. (1978) for European wild boar forest has a L* value of 37.72 lower than our results. Meanwhile, according to Warriss and Brown (1995) Minolta L* value indicates the ability to accept light color of meat and is usually in the range of 49-60.

In Vietnam, Ton and Thang (2009) showed that for three-breed hybrid pigs (DYL), the L* value is 47.21 – 49.54, so this result is equivalent to the result. our research results. The results of measuring the pH of the loin meat immediately after slaughter and 45 minutes after surgery showed that the trend was significantly reduced between the time after 45 minutes, but between the experimental groups, the results were similar. Marcgiori and Felicio (2003) (Excerpt from Ton et al., 2012) stated that the pH of wild boar loin decreased more slowly than that of domesticated and interbred wild boar. The value decreased from 6.18 to 5.57 after 24 hours in wild boar and 6.09 to 5.46 in foreign pork loin. Research by Ton et al. (2012) showed that the pH of 45 minutes for Ban pigs and crossbred pigs (Ban x MC) is 6.13. Hao (2007) also studied in pigs L, Y and F1 (L x Y) that pH45 was 6.12 - 6.19 - 6.15, respectively.

The experiment also studied the concentration of Cholesterol and Triglyceride in the blood of experimental pigs and found that there was a large difference between the batches. Colesterol content tends to increase gradually with the percentage of protein in the diet decreasing from 2.65 – 2.15 – 3.11 mol/L. The content of Triglycerides increases when the percentage of fat in the experimental batches increases. (test batches 2 and 3). This we find, when the diet reduces the percentage of protein, the pigs have to accumulate more energy-rich food, and the pigs accumulate more fat. Therefore, the concentration of Colesterol and Triglyceride increased in the blood of experimental pigs.

Discussion and Conclusion

For the experiment with an energy level of 3000-2900 kcal/kg of feed, with the corresponding protein level of 16-14%, the growth rate increased to 4.31% (0.89 kg/head) and excellent growth. increase 5.59% (5.21 g/head/day); reduced feed consumption in which 4.71% concentrate and 5.97% green feed, and at the same time reduced feed cost by 4.74% compared to the experimental batch with energy level of 2900-2800 kcal/kg food at the same age. Evaluation of pork performance in Experiment 2 between the experiments, there was no significant difference between the ratio of jaw hook, lean meat, and sawn meat, and there was no statistical significance. It also does not affect the chemical composition of the meat.

Thus, for commercial wild boar farming, the diet has a protein level of 16-14% and a metabolic energy level of 3000-2900 kcal/kg of feed in the diet for growth and fattening stages respectively is the

most reasonable, both capable of growth of hybrid wild boar and economically viable in breeding conditions by semi-wild method in ecological conditions of Thai Nguyen.

Recommendations for value-chain approach

In recent years, especially under covid 19 effects, the concept of cycled economy is important to maintain high rate of employment and help the economic growth. Therefore, every stages in wild pigs and pork cycle from input to production and distribution to market need to be in a cycle and can be supported by big corporations. Huy (2015) also stated better management practices needed. Whereas Huy et al (2020) mentioned banks roles in business financing.

Banks also need to finance this value chain or wild pigs and pork cycle.



Figure 2 - Wild pigs feeding in Thai Nguyen, Vietnam (source: internet)

Limitation of research

Due to the limited study time, we have only studied a limited number of studies and have not arranged pairwise comparison plots of each protein reduction level with each corresponding metabolic energy level at the same time, so the results The study cannot comprehensively reflect the influence of crude protein on growth and other economic indicators.

It is recommended that when raising wild boar and crossbreeds, it is necessary to arrange more experiments with some other energy levels to evaluate more accurately. Tinh et al (2021) stated we need to enhance research to explore business aspects. And Huy (2021) confirmed roles of banks in sustainable development while Hac et al (2021) mentioned we need risk management in bank financing which also referred by Huy, (2021), though there are many macro factors affecting (Huy et al 2021). And banks show roles in financing to develop the industry (Huy et al 2021). Hang et al (2021) stated labor force is vital in these business. Then Huy, D.T.N. (2015) stated several management practices needed for doing business, this also mentioned by Huy & Hien (2010).

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