AGLS 6005

ADVANCED NON RUMINANT PRODUCTION

TOPIC 1: THE UTILIZATION OF NON-CONVENTIONAL FEEDS FOR PIGS OR POULTRY

STUDENT: 813004978
ASSIGNED TO: DR. SHELLY BRIDGEWATER

813004978
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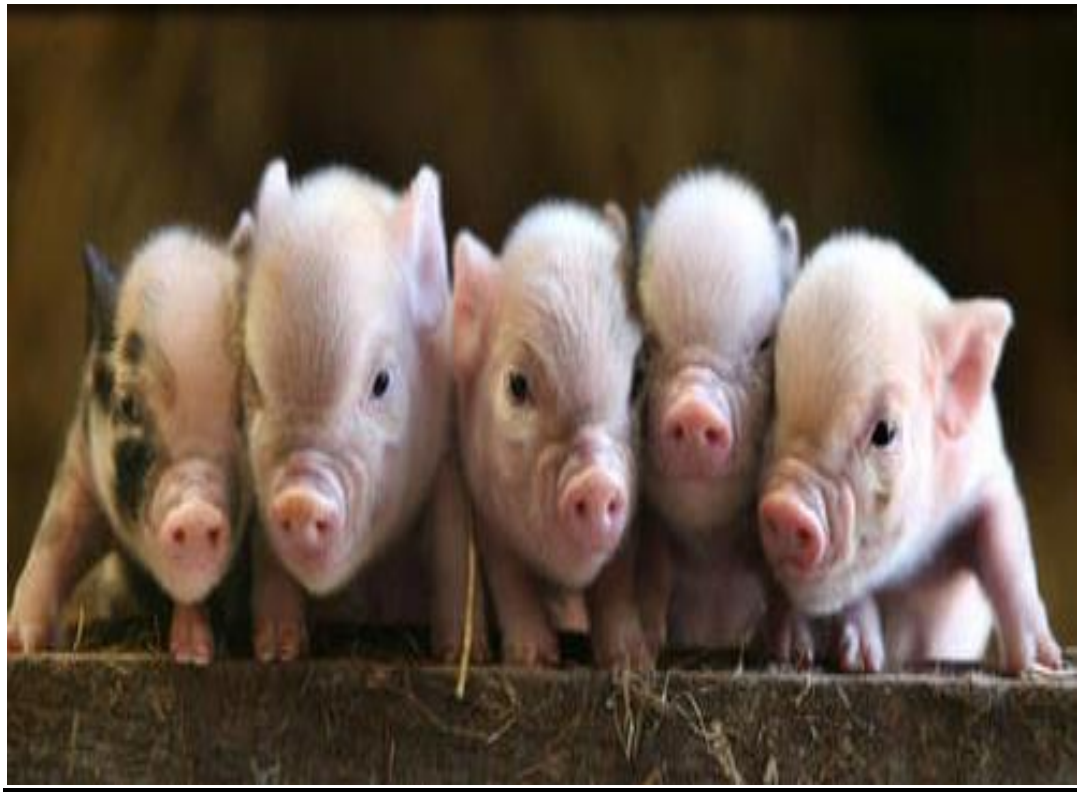
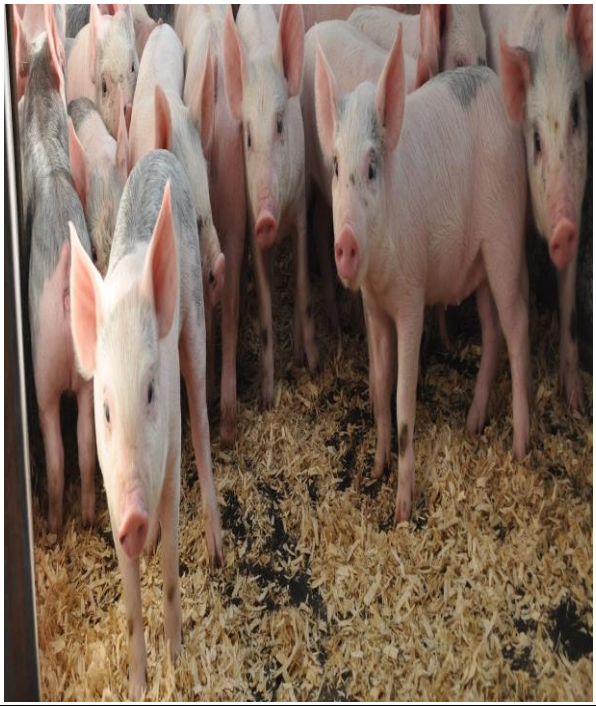
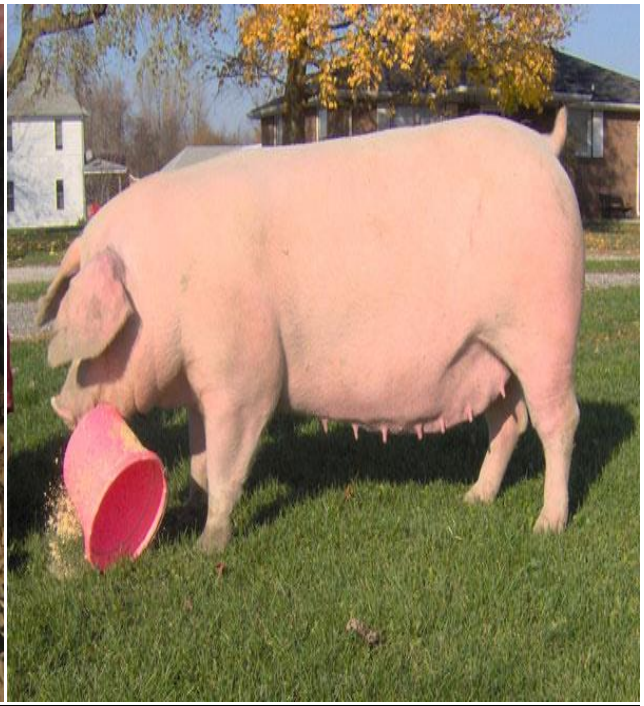
AGLS 6005







Abstract

This paper seeks to identify the Non conventional feed resources (NCFR) that can be used in Pig production systems. Non conventional feed resources are categorised into two main types; Animal sources and Plant sources. It has been found that these resources have played crucial roles in the production costs of the pig industry. Feed costs have been reported to be up to 70% of the total production costs in such an industry. However, use of these non conventional resources also has some specific requirements that must be met before feeding. Procedures of choosing an appropriate feed source are also included in the paper. When using resources of this nature are used in pig diets, there are several factors that can affect the inclusion rate of the resource.

Keywords: Non conventional feed resources, Animal NCFR, Plant NCFR, Inclusion rates

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Glossary of Terms or Abbreviations

CP- Crude Protein

NCFR- Non Conventional Feed Resources

DM- Dry Matter

Literature Review

Why search for Non Conventional Feed Resources?

Pigs are monogastric animals or animals that have a simple stomach. Their digestive system is relatively simple and they don't have the ability to digest and utilise large amounts of fibrous material in their diet like ruminants do. However these animals have the ability to feed resources of varying types. Before explaining what non conventional feed resources (NCFR) are, there is a pertinent reason to justify why there is a need to find alternative sources of feed (Boggess 2008, 2). As the world population increases there is a stiff competition for grain between humans and animals. Humans use grains for ethanol and energy production while animals use this resource as a feed source.

There are three main categories of feed resources as outlined by Devendra (1989, 4). The main categories are crop residues, agro industrial by products and NCFR. Pecu (2009, 279) stated that alternative feedstuffs are crop residues and food industry by products that cannot be consumed by humans and can be fed to pigs. Feed costs accounts for most of the production costs in almost any animal production system but in the pig industry, this cost is as high as 65-75% (Boggess 2008, 2). Corn and soybean have been the major components of conventional feed for monogastrics and satisfy the needs for energy and protein respectively.

However, these components of feeds have become very expensive and in some cases such as corn, scarce. Scientists have been looking for ways to find alternative feed sources for these two components using by products and non edible human consumables from industrial waste. Such non conventional products can be obtained from baking, grain milling, egg processing, brewing, distilling and refining industries. Before any non conventional feed resource is added diet there are a few considerations that must be analysed and tested.

Choices in Selection of Non Conventional Feed Resources

Papadoloulos (1985, 275-276) stated that when using NCFR nutrients contained in feedstuffs should be considered over the type of feedstuff given. Pigs are omnivore and can utilise both animal and plant material to aid in maintenance, growth and production. This author also stated that selection of NCFR should be based on nutritional composition of the feedstuff, cost, availability and palatability. Several questions are asked then if feedstuffs can be used for animal production.

Debates were made: on degrees of accuracy of estimating nutrients of ingredients, consistency of nutrients in the entire composition of the feed stuff, if the feed stuff have any anti nutritional components and is it cost effective to obtain and incorporate these ingredients in the diet. Even if all these questions are answered positively, the main factor is if this new source of feed is acceptable by the animals. A systematic logical flow diagram can be used to access whether a NCFR should be used for animal production. Figure 1 shows the steps taken to evaluate a NCFR:

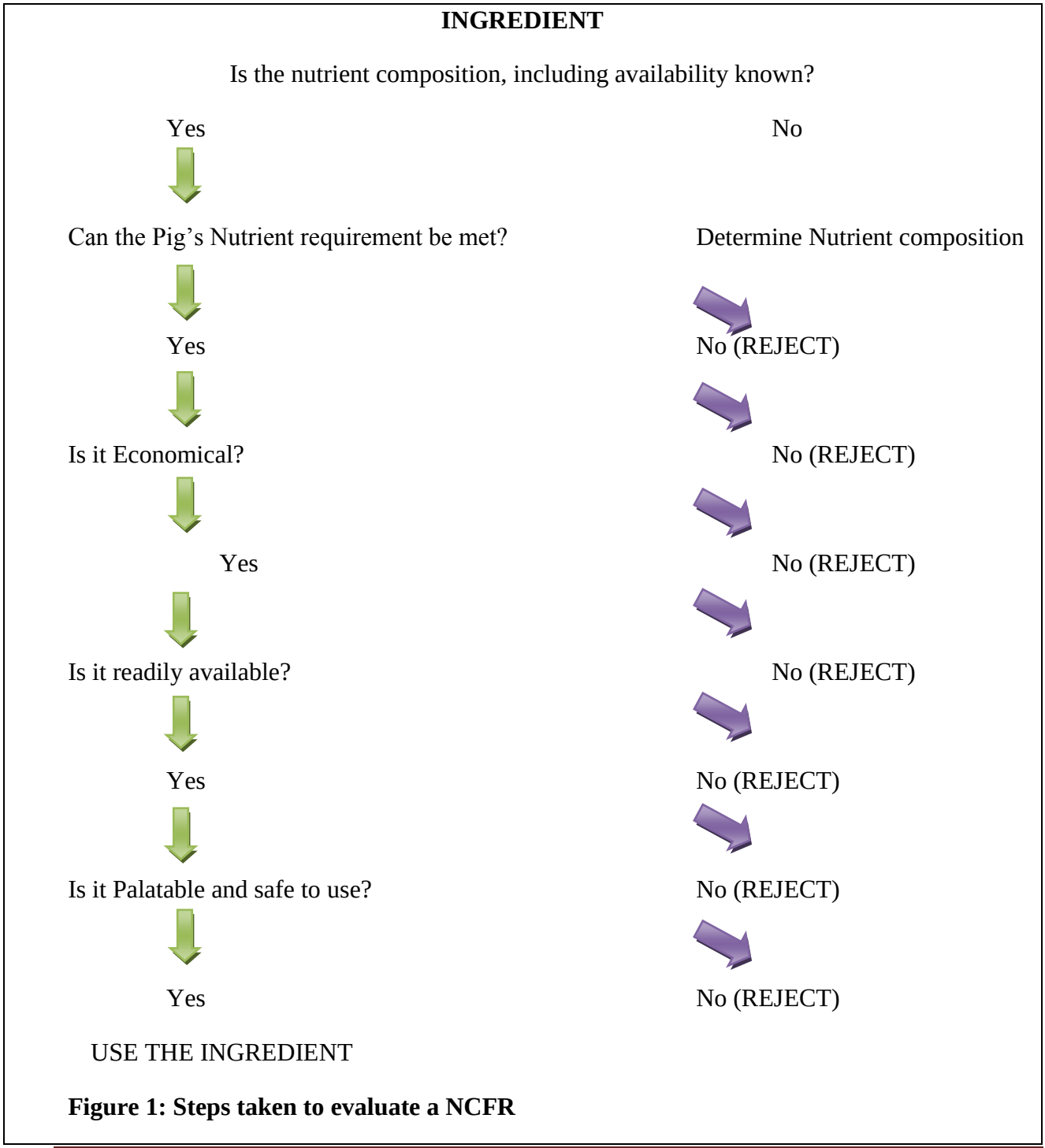

Figure 1: Steps taken to evaluate a NCFR

Types of Non Conventional Feed Resources

There are many types of NCFR that have been proven to work in the pig's diets. However, there are two main categories of NCFR; Animal derived NCFR and Plant derived NCFR. The animal NCFR usually supplements protein to the diet while the plant NCFR supply the energy which takes the place of corn. Since there is a dire need to utilise the NCFR, more research has been geared to find plant based substitutes because energy requirements in pigs are very high.

Animal Non Conventional Feed Resources

Animal NCFR usually originated from sources of the large animal and poultry industry (Preston 1986, 1). The more common products to be used were meat, bone and blood meals. Such products would have been given to the animals either as one single component or combined like meat and bone meal. To a lesser extent, feather meal and hatchery by products such as dead birds and eggs were also reported to be used as animal NCFR. One of the more favourable sources of animal derivatives was fishmeal usually obtained as by-catch from the fish industry. Fishmeal sources have been reported to be high in ash from the bones of the fish and high in oils if the entire fish was used (Preston 1986, 1).

Alaskan studies have shown that marine by-products contain approximately 63% CP and are highly digestible when fed to pigs. This resource has also been examined and found to be a rich source of B vitamins, few minerals and a good balance of amino acids(Alaska Extension 2011, 1-2). Diets fed to pigs in Alaska would contain no more than 4% total fishmeal because of the possibility of fishy flavour. Crabmeal is another animal NCFR that Alaskans use which contains about 35% CP but less lysine and energy than fishmeal. Though there is deficiency in these two components, Crabmeal is higher in calcium and fiber but not as digestible. The maximum rate included in a diet should be no more than 6% (Alaska Extension 2011, 1-2).

Blood meal is a high protein ingredient derived from animal blood but quality varies among species and processing techniques. Blood meal is usually approximately 20% DM and is fed in the powdered form. Recent studies have shown that blood is now used in the liquid form and sprayed onto fed and is good for starter pig diets (Papadopoulos 1985, 54).

Bone meal was used in large quantities in previous years but recently because of cost factors, the use has been regressing. This NCFR is high in calcium and phosphorus in amounts of 24% and 12% respectively. Feather meal is rich in CP but is relatively not digestible to pigs. It was noted that feather meal can be used in pig diets, only if the pig's diets composition is known.

A recommended use in grower and sow diets are 3-4% of the total diet (Papadopoulos 1985, 55). Edwards 2002 also agreed with Preston 1986 and Papadopoulos 1985 in terms of animal NCFR but added to the list full fat soya, full fat rapeseed, rapeseed meal, beans, peas and lupins to increase the CP in the diet.

Milk provides more essential nutrients than any other feed in gradient but is not used solely as a NCFR in pig diets because of its use to humans (Ekstrom et al. 1975, 62). Milk is an excellent source of amino acids, phosphorus, vitamin A, riboflavin and a good source of niacin, thiamine and vitamin B-12. It should be noted however, that milk has a low source of iron and should be fed only with mineral mixes for maximum benefits in pig diets (Ekstrom et al. 1975, 62).

More recent studies have been done to find even more alternative sources of animal feed. Sogbesan and Ugwumba 2008 conducted an experiment using unskinned dried tadpole meal, termite meal, garden snail meal and fishmeal. Tadpole meal was noted to have 43.50% CP value which was the lowest value of the four meals. Garden snail had the highest crude lipid content of 30.50% while termite meal having the highest gross energy of 2,457.61 kJ/100 g. Garden snail meal also contained the highest sodium and potassium levels (Sogbesan and Ugwumba 2008, 1160). This study showed that fishmeal was superior in few categories of nutrient comparisons but alternative sources can be used for pig production.

Figure 2: Earthworm Meal Pellets (Left), Blood Meal (Middle) and Termites used to make Termite Meal (Right)

Plant Non Conventional Feed Resources

In (2009, 280) Pecu stated several plant sources that can be used as NCFR. Rice polishing, bananas, cassava tubers, sugarcane juice and potatoes have all proven to beneficial ass NCFR but had to undergo some form of processing to be at the right feeding quality. Preston (1986, 2) also agreed using NCFR such as rice polishing and bananas, but also included ingredients from the milling industry like wheat millings, maize gluten and sorghum gluten.

Preston also reported that products from the oil industry, sugar industry and fruit processing industry can be used. These by products were meals after oil extraction of cotton, soybean and sunflower, molasses and sugar beet pulp, citrus and pineapple pulps as well as fresh fruits that were not consumed by humans. There was also another type of NCFR that was not explored fully but included by products from the fermentation industry like yeast from brewing or torula yeast from molasses fermentation.

A study was carried out in Alaska where non traditional feed sources were used to rear pigs because pig production feed costs were up to 75% (Alaska Extension 2011, 1-2). NCFR used in this part of the world ranged from silage crops, dairy products, candy, and raw vegetables to stale bakery products. Sugars were obtained from the candy, minerals and vitamins from the dairy products depending on the moisture content, energy from the vegetables and fiber from the silages.

Two scientists in Ghana, Okai and Boateng (ND) spoke about using NCFR from products that they have in their country. There are three main products that are obtained from the Oil palm industry, oil palm slurry, the palm kernel cake and the palm press fiber. An experiment was carried out using the palm kernel cake and results showed that the back fat thickness of pigs was higher than those not fed the cake. It was also noted that the palm press fiber had a positive impact of growing finishing pigs since oil extraction techniques were quite inefficient so ether extracts in the product were high.

Archimède et al. 2011 did an experiment on alternatives to using soybean in the tropics. This study showed that there are alternatives to soybean meals in the tropics which include beans, peas, aquatic plants or leguminous foliage. In the tropics there are two main sources of animal NCFR; those from protein legumes and those from animal by products (Archimède et al. 2011, 275). Studies have shown that plants based derivatives such as cassava leaves, Giant Taro 24% CP, Gliricidia leaves, azola, duckweed 35% CP, Morus Alba leaves and sweet potato leaves 32.5% CP can all be utilised by pigs in varying degrees.

A study on small holder pig production was carried out by Phengsavanh 2013 and some NCFR were found to be very useful. This author focused mainly on using forage legumes for feed substitution. He stated that protein was the most limiting nutrient for tropical pig production. He then suggested that using legumes in a leaf meal form in the diet would be helpful in the production dilemma. Results showed that using Leucaena leaf meal was nutritionally on par with soybean meal. Further experimentation showed that using the leaf meal had a slight negative effect in terms of voluntary feed intake supposedly because of the levels of the fiber in the forage.

Organic pig farming was explored heavily by Edwards (2012). This author summarised that there were many plant sources that can be used to promote growth of pigs at different physiological states. These NCFR included: barley, wheat, oats, rye, triticale, wheat bran, carrots, parsnips, fresh clover, grass meal, Lucerne silage, and whole crop silages. All NCFR had positive effects on pig production by as Prestion (1986) suggested, they all needed to be partially processed before feeding.

Adesehinwa (2009) used a combination of plant source NCFR on growing crossbred Large White x Landrace pigs. The NCFR was palm kernel cake with two levels of cassava flour waste. Results were very positive as average daily weight gains were increased, feed efficiency and protein utilisation was better than that of the control pig group. An FAO publication done by Devendra 1985 also showed that even more plant based NCFR that can be used. All NCFR stated by Devendra was in alliance with the suggestions of all other authors in the paper thus far. However, it was also stated that more work needs to be done on these NCFR because of the possible problem of anti nutritional factors in each feedstuff.

Figure 3: Sugar beet pulp pellets (Left), Citrus pulp pellets (Middle) and Palm Cake Kernel (Right).

Factors affecting Inclusion rate of Non Conventional Feed Resources

When using alternative feed resources, cost is usually the most important factor in the decision making process. Replacement foods can supply nutrients to the diet and will be beneficial to the product system, but as with any operation, there needs to be accounting of investments. Though the by product may be cheaper than other sources, factors such as transportation, special processing needs and storage must be taken into account (Boggess 2014, 2-3). Relative values of NCFR are very important in determining the nutrient requirements and how they are to be supplied to the animal. Relative values of NCFR are comparable to corn and protein profiles, mainly the three most important nutrients in the swine's diet: energy, lysine and phosphorus.

It cannot be stressed how much lysine plays a role in the pig's diet. This makes the choice of protein sources very critical. Swine diets are usually based on levels of lysine and not crude protein requirements (Boggess 2014, 4). Digestibility also plays a role in the utilisation of NCFR. New food sources may be nutritious and cheap but they may not be palatable due to the fibrousnesses of the feed. There are also anti nutritional factors in products which interfere with nutrient digestibility. Such compounds are trypsin inhibitors, tannins, lectins or glucosinolates.

The inclusion rate of ingredients will solely be dependent on palatability, nutrient availability, protein quality, nutrient interrelationship and the method of processing as well as feeding techniques. Stability of nutrients also plays a role in feed intake volumes because of the nature of ingredients to remain or not remain in its original form (Boggess 2014, 6-9). For instance, vegetable oils are the first to get rancid if not treated with an antioxidant. Nutrient variability in NCFR such as bakery products have been reported to show the most variation in nutrients based on age of waste.

Advantages of using Non Conventional Feed Resources

Using NCFR has many advantages if these resources are used properly in such a lucrative business as the pork industry. Here are some advantages of using NCFR:

1) Lowers feed costs for commercial producers
2) Allows the small scale producers to earn a living
3) There is minimal wastage of industrial by products
4) There are carcass alterations which are profitable in some operations
5) Less chemical treatments are used and pigs can be grown on a more organic diet
6) Further research can be done on genetic variation and growth potential of pigs fed NCFR
7) Manure produced can be placed directly into crop production

Discussion

Pork is a well consumed type of meat but turning conventional feeds into meat is very costly. NCFR can help with lowering of the feed costs in pig production. NCFR can be derived from animal and plant sources and serve to aid in the pips' growth and production. However, as discussed previously there are several factors that must be taken into consideration when including NCFR into diets. If all criteria are met and resources are available pork production will benefit heavily from these resources. NCFR offer tremendous amounts of advantages to producers of both the large and small scale.

Conclusion

NCFR are very useful in the production of pork. Hence a wide variety of experiments have been carried out to find the sources with the best nutritional values in terms of lysine and energy contents. Feed costs are very high in the monogastric industry and alternative feed sources are keys to making the production systems a profitable one both in the economic and financial departments.

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Appendix

Table 1: Nutrient Profiles of Common NCFR in Pig Diets (Boggess 2014, 2-3)

By-product	Metabolizable energy	Dry Matter	Crude Fiber	Protein	Lys	Trp	Ca	P
Milk by-products	kcal/lb.			%				
Liquid whole milk	290	12.8	0.0	3.4	0.25	0.05	0.12	0.09
Dried whole milk	2,200	97.0	0.1	26.0	2.09	0.37	0.91	0.75
Liquid skim milk	160	9.5	0.0	3.4	0.30	0.05	0.12	0.10
Dried skim milk	1,520	94.0	0.3	33.5	2.50	0.45	1.25	1.00
Liquid buttermilk	155	9.7	0.0	3.3	0.26	0.04	0.13	0.09
Condensed buttermilk	493	29.1	0.1	10.8	0.78	0.12	0.44	0.26
Dried buttermilk	1,380	93.0	0.4	32.0	2.20	0.47	1.32	0.93
Liquid sweet whey	103	7.1	0.0	0.9	0.07	0.01	0.05	0.05
Liquid acid whey	95	6.6	0.0	0.8	0.07	0.02	0.10	0.08
Dried whey	1,445	94.5	0.2	12.0	0.80	0.13	0.90	0.70
Dried whey product	1,240	92.0	0.2	16.0	1.40	0.22	1.69	1.13
Meat by-products								
Animal fat	3,550	95.0	0.0	0.0	0.00	0.00	0.00	0.00
Meat meal	1,200	92.0	0.4	55.0	3.00	0.35	8.20	4.10
Meat and bone meal	1,100	93.0	0.4	50.0	2.50	0.28	10.10	5.05
Flash dried blood meal	1,300	90.0	0.6	85.0	7.00	1.00	0.30	0.25
Hydrolyzed hog hair	1,000	95.0	1.0	94.0	3.50	0.50	0.20	0.80
Hydrolyzed feather meal	1,000	94.6	1.0	85.0	1.94	0.50	0.20	0.80
Poultry by-product meal	1,300	93.0	1.0	55.0	3.70	0.45	4.40	2.50
Egg by-products								
Bloodspot eggs	500	40.0	0.0	10.0	0.50	0.10	6.00	0.20
Hatchery by-product meal-broiler chick	800	90.0	0.0	22.2	1.16	0.22	24.60	0.33
Hatchery by-product meal-egg chick	1,000	90.0	0.0	32.3	1.83	0.30	17.20	0.60
Grain by-products								
Corn bran	1,200	89.0	8.5	8.0	0.20	0.10	0.03	0.20
Hominy feed	1,400	90.0	5.5	10.4	0.30	0.10	0.05	0.40
Corn gluten feed	1,100	90.0	10.0	22.0	0.60	0.12	0.30	0.70
Corn gluten meal	1,400	91.0	2.0	42.0	0.80	0.23	0.03	0.45
Wheat bran	890	90.0	11.0	15.0	0.56	0.18	0.10	1.15
Wheat middlings	1,300	88.0	7.0	16.0	0.64	0.18	0.10	0.90
Rice bran	1,350	91.0	12.0	13.0	0.60	0.10	0.10	1.30
Rice bran, fat extracted	1,200	91.0	11.4	16.0	0.60	0.18	0.13	1.32
Rice polishings	1,500	90.0	4.0	12.0	0.50	0.10	0.05	1.20
Brewers dried grains	1,000	92.0	13.0	25.0	0.90	0.30	0.25	0.50
Distillers dried grains	1,300	93.0	11.0	25.0	0.60	0.20	0.10	0.35
Distillers dried grains w/solubles, Old Generation	1,540	91.0	10.0	27.0	0.70	0.20	0.15	0.70
"" New Generation	1,633	91.0	7.8	27.0	0.70	0.20	0.06	0.79
Stillage	150	10.0	1.0	3.0	0.08	0.02	0.02	0.10
Dried bakery by-product	1,650	92.0	1.0	10.0	0.30	0.10	0.06	0.47
Starch and sugar by-products								
Cane molasses	1,060	77.0	0.0	4.5	0.20	0.10	0.81	0.08
Dried cane bagasse	500	91.5	44.5	2.0	0.10	0.05	0.60	0.20
Beet molasses	1,060	77.5	0.0	6.6	0.15	0.05	0.12	0.03
Dried beet pulp	1,020	90.6	18.2	8.7	0.65	0.09	0.68	0.09
Corn molasses	1,200	73.0	0.0	0.4	0.00	0.00	0.04	0.04
Salvage candy	1,600	93.5	0.0	3.0	0.00	0.00	0.06	0.06
Vegetable and fruit by-products								
Cooked cull potatoes	370	22.0	0.7	2.2	0.06	0.02	0.02	0.06
Potato meal	1,100	90.0	2.0	9.0	0.25	0.10	0.10	0.30
Potato flakes	1,600	90.0	2.0	9.0	0.25	0.10	0.10	0.30
Potato slices	1,500	90.0	2.0	9.0	0.25	0.10	0.10	0.30
Potato pulp	1,000	90.0	6.0	7.7	0.20	0.10	0.10	0.30
Potato chips and fries	2,000	90.0	2.0	5.0	0.20	0.10	0.10	0.30
Cooked cull dry beans	1,400	90.0	4.0	23.0	1.50	0.20	0.20	0.40