The Analysis of Agricultural By-Products to be used as Animal Feeds on Hawaii Island
L. Stevens, M. W. DuPonte. and R. Jha
College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa

Objectives
- Identify By-Products that are useful in swine diets
- Present Nutrient values of By-Products
- Show how these By-Products may be utilized in swine feeding.

Introduction
The increasing demand for corn and other grains for international trade and conversion into ethanol and bio-diesel in the United States has caused dramatic rise in the price of feed to livestock production. In Hawaii, due to limited land availability, the use of large parcels of agricultural lands for production of grain for animal feed is economically unfeasible. Therefore local swine and poultry producers are forced to rely on expensive, imported feed for their needs. As a result of increased feed costs, the number of livestock producers in Hawaii is on the decline.

Fruit, vegetables and root crops play an important role as staples in the human diet in the islands. As a result, there is a wide range of potential by-products and residues from food crops which are often under-utilized or wasted. Much of these by-products are now being fermented and fed to animals by many sustainable agriculture farms on the Big Island.

Nutrition plays an important role for the health and productivity of agricultural animals. Providing proper nutrition is much more than just purchasing a bag of feed or putting animals on pasture. The producer should be knowledgeable about the fundamental makeup of animal nutrition, physiology and husbandry. The six foremost groupings of nutrients include water, protein, carbohydrates, fats, minerals, and vitamins which will vary according to different occurrences such as age, pregnancy, and usage. Nutritive deficiencies or excessive misuse of minerals could cause health impediments in animals leading to mortality. By understanding the nutritional requirements of an animal and how the digestive system functions will enable producers to manufacture a balanced ration. The ultimate goal of any animal producer is an economical balanced ration that convives with the animal’s nutritional requirements.

Standard Operating Procedures: Alternate Feed Trial

- Weighting Animal
  - All animals are initially weighed, and randomly assigned to either a control group or a test ration group (treatment group).
  - Weight is taken every two weeks in a 16 week trial.
- Pre-Trial Feeding
  - Test ration is gradually introduced over a 10 day period, each day replacing a larger portion of their commercial feed ration.
- Trial Feeding
  - Feed is weighed, and fed once a day. Any uneaten food will be collected and weighed to determine maximum consumption.
- Animal Observation
  - Animals are observed daily for signs of stress, weight changes, and eating habits.
  - If animal is not eating, remove from trial, and return to commercial ration.
- Feed Preparation and Storage of Test Ration
  - Feed rations should be stored in plastic covered barrels, and sub-sampled daily as its weighed out for feeding.
  - Feed sample to be submitted for nutrient analysis
  - Feed samples to be prepared for 10-14 days, to ensure feed is feed before shelf life expires.

Above is a glimpse of a factsheet. This factsheet provides practical nutrient information for producers to help develop an economical balanced animal ration using local astute feedstuff available in Hawaii.

Pearson’s Square
The Pearson’s Square or box method is a simple, quick way to calculate the amounts of feed necessary to meet a nutrient requirement of livestock and other animals. This method is most effective when only two feeds are being used. For example, when two grains are mixed for part of a total mixed ration (TMR) or as a supplement to pasture feeding. A Pearson’s Square can be used to determine what quantity of each commodity would be needed to achieve a specific nutrient level in the mixture.

In taking a close look at the square, several numbers are in and around the square. Probably one of the more important numbers is the number that appears in the middle of the square. This number represents the nutritional requirement of an animal for a specific nutrient. Subtract the nutrient value from the nutritional requirement on the diagonal and arrive at a numerical value entitled parts. Disregard any negative numbers calculated on the right side of the square. Treat them as positive numbers.

The example above shows the Pearson’s Square being used to determine the ratio of grain to supplement to create the 16% protein ration needed in our example. Pearson’s Square shows that you need to mix 85 percent grain with 15 percent of the protein supplement to make a 16 percent protein grain ration.

By summing those parts and dividing by the total, you can determine the percent of the ration that each ingredient should represent in order to provide a specific nutrient level. Always subtract on the diagonal within the square in order to determine parts. Always double check calculations to make sure that you did not have a mathematical error. It also is very important to work on a uniform basis. Use a 100-percent dry-matter basis for nutrient composition of ingredients and requirements and then convert to an as-fed basis after the formulation is calculated.

Conclusion
The greatest part of a livestock ration is made up of protein and energy, for which animals have the highest demands to remain healthy, grow strong, and to be productive. The Pearson Square is a fast and simple way to calculate a desired amount of crude protein or energy for a mixed ration using basic math. However, disadvantages occur since the method does not account for vitamins or minerals of a feedstuff being tested and incorporated in a total mixed ration. The benefits of using a balanced ration far outweigh the disadvantages, but each farm has different goals and capabilities that may or may not adapt well. Feed cost can be reduced by replacing some of the high-priced grains with local agricultural by-products. However, each by-product should be analyzed to serve as an alternative to some imported grain replacement when creating locally produced feeds. It would be valuable for a livestock producer to experiment with a free and user-friendly ration balancing program in order to create a least-cost ration. Since grain prices will likely continue to increase in price, as they have done recently, it may be the only way to remain profitable in the future.

References
6. Table D E. and T. Thrasher, 2015, Swine Feed and Ingredient Sampling and Analysis. FSG 07-04-02. www.usporkcenter.org