optimum quantity and quality of life. For ethics is a behavioral science. Our fate depends upon it.

But I'm afraid it is too late. Our technological "progress" has acquired such momentum that it is probably unstoppable. This so-called progress has overshot the mark in increasing the quantity of life; it has largely ignored the true quality of life. We have the technical ability to solve our problems: we lack the scientifically sound ethical precepts and moral commitments that would lead to an improvement of the quality of life. Though I have not proposed here a system of ethics that would solve the problems we face, I think most of us, granted the above, could do so. I will say one thing: an increase in quantity, can destroy, not only the quality of our life, but the very life of our species itself. But all I can do is cry out in the "concrete jungle" with words of warning. And all of us must do so with practicality, aware of man's biological history and seeking in a knowledge of his evolution clues to the right path for him to follow.

But, as William Blake said, "Man was made for Joy and Woe"; and as Robinson Jeffers put it, "Life was never bonded to be endurable nor the act of dying pleasant". Yet I feel with the unknown Aztec poet from Chalco:

"Oh friends, this earth is but a loan.
We must leave our beautiful poems,
We must leave our wonderful flowers.
So I am sad when I sing for the sun."

And if any of you do not like what I have said or find the thinkable unthinkable, I can only answer you with the words of the Shropshire Lad:

"Ale, man, ale's the stuff to drink
For fellows whom it hurts to think."

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DIGESTION OF CRUDE PROTEIN IN WHITE OAK ACORNS BY EUROPEAN WILD HOGS AND PITMAN-MOORE MINIATURE HOGS

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Abstract

Digestibility of crude protein in acorns was investigated with both European wild hogs *(Sus scrofa)* and Pitman-Moore miniature swine *(Sus scrofa domesticus)*. Contrary to published information, the hogs digested approximately one-half of the crude protein in acorns. The percentage of apparently digested crude protein ranged from a low of 30 to a high of 65. The two strains of hogs were similar in their ability to digest acorn protein.

Introduction

Acorns are a major dietary constituent in the fall and winter months of the European wild hog in the Tellico Wildlife Management Area in Tennessee (Henry, 1968, personal communication). White oak acorns contain approximately 3 percent crude protein on a wet basis, which is reported to be totally indigestible (Morrison 1956). Since the domestic hog requires ten essential amino acids (N.R.C., 1968) and additional protein for the synthesis of nonessential amino acids, it would appear that European wild hogs would be seriously deficient in protein during the fall and winter if entirely dependent on acorns. Therefore, the objective of the present study was to determine the percentage of crude protein in acorns and its digestibility by European wild hogs. In addition, crude protein digestibility by European wild hogs was compared to that by Pitman-Moore miniature swine.

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Methods

A total-collection digestion trial was conducted with three European wild hogs 6 months of age, progeny from the Tennessee Game and Fish Commission's research herd at Tellico Plains, Tennessee, and three Pitman-Moore miniature swine of similar age and size. The animals were placed in individual metabolism stalls described by Mayo (1961) and remained there for 14 days. During the first day they were fed a commercial swine ration which they had received before the beginning of the trial. For the next 2 days, the change-over period, the diet consisted of one-half of the commercial ration and one-half of whole white oak *(Quercus alba)* acorns. Then followed a 6-day "preliminary feeding period" during which the hogs were adjusted to their experimental ration which consisted entirely of whole white oak acorns from which the caps had been removed. During the next 5 days, the "collection period", the same feeding regimen was continued and feed intake was measured. During both the preliminary and collection period, 800 grams of acorns without caps were offered to each hog daily. Actual acorn meat consumption is reported in Table 1. During the collection period, all feces and urine were collected from each hog metabolism cage at 8:30 a.m. and 3:30 p.m., weighed and stored under re-

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frigeration. The urine was acidified to decrease bacterial activity.

At the conclusion of the collection period, the daily fecal samples collected from each hog were pooled, mixed, and oven dried at 80 C for 72 hours. The samples were then allowed to air-equilibrate to a constant weight, and the loss of weight during the drying process was recorded as air-equilibrated moisture in the original sample. The air-equilibrated fecal samples and a representative sample of acorns were ground to pass through the medium mesh screen (2 mm) of a Wiley mill, subsampled and stored in glass jars.

The Kjeldahl method (A.O.A.C., 1965) was used to determine the amount of crude protein (N x 6.25) in feed, feces and urine samples. Duplicate 2-gram aliquots of acorns and fecal samples as well as 3-ml aliquots of the urine samples were analyzed. The specific gravity of the urine was recorded so the amount of nitrogen in the urine analyzed could be converted to a weight basis.

Apparent digestion coefficients of crude protein were calculated by the following formula:

$$\text{Digestibility, } \% = \frac{\text{Crude protein consumed-fecal crude protein}}{\text{Crude protein consumed}} \times 100$$

Urinary nitrogen together with dietary and fecal nitrogen were used to determine nitrogen balance.

Results and Discussion

The crude protein content of the acorns without caps was 5.47 percent on a moisture-free basis. However, the crude protein content of the refused material which consisted mainly of the hulls averaged 3.9 percent on a moisture-free basis. This increased the crude protein content of the portion actually eaten, from which the crude protein digestibility was calculated.

During the 5-day collection period, the hogs in both groups consumed approximately 2.1 kg of acorn meat each containing an average of 126.5 grams of nitrogen (Table 1). The amount of nitrogen digested varied greatly among hogs, ranging from a low of 38 to a high of 78 grams for the experimental period. Apparent nitrogen digestibility ranged from a low of 30.2 percent to a high of 65.5 percent, indicating that approximately one-half of the acorn protein was digested. The two strains of hogs were similar in their ability to digest acorn protein (nitrogen). These results are in contrast to those by Morrison (1956) who reported that none of the crude protein in white oak acorns was digested. It should be pointed out, however, that it was not stated by Morrison with what animal species the digestion trials had been conducted.

In practice, true protein digestibility in acorns should be even higher than the apparent crude protein digestibility reported in this study. This increase is due to the error in calculating apparently digested protein which is caused by the presence of the metabolic nitrogen in the feces. Furthermore, most European wild hogs feeding on acorn mast in the winter are older than the 6-month hogs used in this study. Since digestibility of protein by swine increases as the animals get older and heavier (Kornegay et al., 1965; McConnell et al., 1971), it might further be postulated that acorn protein digestibility under normal field conditions might be higher than the values obtained in this study.

All the animals were in negative nitrogen balance during the trial, since the combined fecal and urinary nitrogen excretion exceeded nitrogen intake. The hogs in both experimental groups lost an average of about 5.0 grams of nitrogen per day. Obviously, hogs cannot remain in negative nitrogen balance for extended periods of time. The negative nitrogen balance may be partially explained by the change from the high-protein commercial ration (16 percent) at the beginning of the trial to the low-protein acorn ration (5.47 percent).

The results from this study show that European wild hogs can utilize at least half of the crude protein in acorns. However, since the crude protein content in acorns is low (5.47 percent), the digestible crude protein content would only be about 2.5 percent. Undoubtedly, European wild hogs supplement their high-acorn diet with high-protein materials such as insects, rodents, and carrion since these items were found in the stomachs of hogs during the fall and winter (Henry, 1968, personal communication), and which would improve their nutritional status in regard to protein.

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TABLE 1. Nitrogen digestion and nitrogen balance of hogs during the 5-day experimental period.

Item	Hog number					
	European wild hogs			Pitman-Moore hogs		
	656	657	658	653	654	655
1. Acorn meat consumed* (g)	2,382	2,234	2,136	1,705	2,144	2,066
2. Nitrogen consumed (g)	136	131	128	113	126	125
3. Nitrogen excreted feces (g)	86	53	60	39	88	75
4. Nitrogen apparently digested (g)	50	78	68	74	38	50
5. Apparent nitrogen digestibility (%)	36.8	59.5	53.1	65.5	30.2	40.0
6. Nitrogen excreted urine (g)	86	99	89	82	63	88
7. Net nitrogen loss (g)	36	21	21	8	25	38
8. Nitrogen loss/day (g)	7.2	4.2	4.2	1.6	5.0	7.6

*Moisture-free basis.