Cattle Diet Digestibilities Determined from Components

HENRY A. PEARSON

Rocky Mountain Forest and Range Experiment Station,[1] Flagstaff, Arizona.

Highlight

In vitro digestibilities of diet mixtures and of individual forage species, adjusted for their relative proportions in the range cattle diet, were interchangeable.

Digestibility trials give better estimates of forage nutritive value than do chemical analyses (Cook et al., 1962). Whether the digestibilities of several individual forage species can be used to infer information about animal dict mixtures containing the same species has been questioned, however (Van Dyne and Heady, 1965). The investigator must assume identical digestibility for a species digested individually and in a mixture of other species. Dietz et al. (1962) found individual forage digestibilities were not additive in predicting total digestible nutrients in deer forage. Swift (1957) also found nonadditive effects when feeding concentrates with forages.

This note presents results from in vitro digestibility analyses of individual forage species in the cattle diet, and their relationship to digestibility of the cattle diet mixture.

Methods

Forage samples for in vitro analysis were collected from a ponderosa pine range grazing study area in northern Arizona (Pearson, 1964). These samples, collected at 6-week intervals during the summer consisted mainly of: Arizona fescue (*Festuca arizonica* Vasey), mountain muhly (*Muhlenbergia montana* (Nutt.) Hitchc.), bottlebrush squirreltail (*Sitanion hystrix* (Nutt.) J. G. Smith), sedge (*Carex geophila* Mackenz.), crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), intermediate wheatgrass (*A. intermedium* (Host)Beauv.), pine dropseed (*Blepharoneuron tricholepis* (Torr.) Nash.), and mutton bluegrass (*Poa fendleriana* (Steud.) Vasey). Forbs such as thistle (*Cirsium* spp.), lupine (*Lupinus argenteus* Pursh), groundsel (*Senecio neomexicanus* Gray), and others in the cattle diet were also collected.

Forty-five pairs of 9.6-ft² plots (one caged, one uncaged) were located in each of 7 experimental pastures for measuring cattle diets. Each forage species in the caged plots was clipped to match the stubble height in paired grazed uncaged plots. The 45 samples from each pasture were then combined, keeping each species separate. Nineteen of these combinations were used in this study. The clipped samples, assumed to be representative of the cattle diet, were used for in vitro digestibility determinations. An aliquot of each species sampled was kept separate for individual digestibility determinations. Species were also combined in proportion to amount (oven-dry weight) consumed from the paired plots. Digestibility of this mixture represented the digestibility of the diet of the grazing animal, and will hereafter be referred to as the "diet mixture" digestibility. Digestibilities of individual species were weighted in accordance to their diet proportions, and will be referred to as the "weighted average" digestibility. A sample diet computation is shown in Table 1, with a known "diet mixture" digestibility of 50.0%.

Table 1. A weighted average diet digestibility.

Species in diet	Weighted diet proportions	In vitro digestibility (Percent)	Weighted digestibility (Percent)
Arizona fescue	0.203	48.0	9.74
Mountain muhly	.402	46.5	18.69
Bottlebrush squirreltail	.300	51.8	15.54
Sedge	.040	58.7	2.35
Pine dropseed	.018	50.8	0.91
Mutton bluegrass	.023	67.2	1.55
Thistle	.010	52.1	0.52
Lupine	.004	76.3	0.31
Sum	1.000		49.61

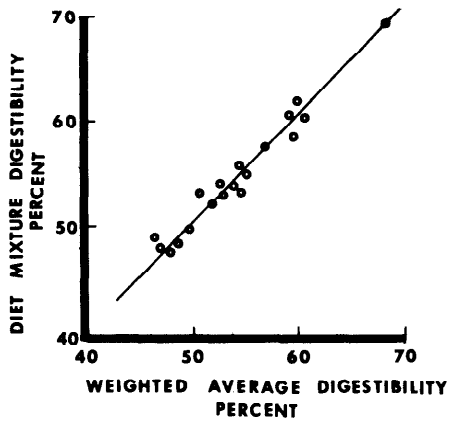

FIG. 1. "Weighted average" diet digestibility versus the "diet mixture" digestibility.

The in vitro dry matter digestion techniques used in these studies followed those of Tilley and Terry (1963) as modified by the filtration procedure described by Alexander and McGowan (1961). Each determination was in triplicate.

Results and Discussions

"Weighted average" and "diet mixture" digestibilities were highly correlated ($r=0.975, df=17$, Fig. 1). The relationship is expressed by the equation $Y=1.017X$, where Y is percent in vitro digestibility of the diet mixture and X is percent in vitro digestibility of the weighted average. Standard errors of triplicate digestibility determinations were within 4% of the means. Since the regression coefficient approaches 1, these digestion values are interchangeable: percent digestibility of separate forage species and their proportions in the diet can be used to calculate diet mixture digestibility. These findings are somewhat contradictory to in vivo studies where nutritive values of forage and supplemental concentrates were not additive (Swift, 1957). These differences are not surprising since rough-

[1] *Forest Service, U.S.D.A., with headquarters at Fort Collins, in cooperation with Colorado State University. Research reported here was conducted at Flagstaff in cooperation with Northern Arizona University.*

age-concentrate diets include a much wider range of digestibilities than diets consisting entirely of range forages. Differences where individual nutrients were analyzed (Dietz et al., 1962) are unexplainable, since the range of digestibilities was similar.

LITERATURE CITED

ALEXANDER, R. H., AND MARY MCGOWAN. 1961. A filtration procedure for *in vitro* determination of digestibility of herbage. J. Brit. Grassland Soc. 16:275-276.

COOK, C. WAYNE, HAROLD H. BISWELL, R. T. CLARK, E. H. REID, L. A. STODDART, AND M. L. UPCHURCH. 1962. Basic problems and techniques in range research. Nat. Acad. Sci.-Nat. Res. Counc., Washington, D.C. Publ. 890. 341 p.

DIETZ, DONALD R., ROBERT H. UDALL, AND LEE YEAGER. 1962. Chemical composition and digestibility by mule deer of selected forage species, Cache La Poudre Range, Colorado. Colo. Game and Fish Dep. Tech. Bul. 14. 89 p.

PEARSON, HENRY A. 1964. Studies of forage digestibility under ponderosa pine stands. Soc. Amer. Forest. Proc. 1964: 71-73.

SWIFT, R. W. 1957. The nutritive evaluation of forages. Penn. Agr. Exp. Sta. Bul. 615. 34 p.

TILLEY, J. M. A., AND R. A. TERRY. 1963. A two-stage technique for the *in vitro* digestion of forage crops. J. Brit. Grassland Soc. 18: 104-111.

VAN DYNE, G. M., AND H. F. HEADY. 1965. Interrelationships of botanical and chemical dietary components of animal grazing dry annual range. J. Anim. Sci. 24:305-312.