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NUTRITIONAL CONTENT OF SELECTED ABORIGINAL FOODS IN NORTHEASTERN COLORADO: BUFFALO *(BISON BISON)* AND WILD ONIONS *(ALLIUM SPP.)*

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ABSTRACT.—An examination of the nutritional content of wild onions and of bison meat is an outgrowth of archaeological research conducted by Colorado State University. Archaeological studies in north-central Colorado indicate more than 10,000 years of occupation by hunting and gathering nomadic American Indians. The sites are located at elevations ranging from over 12,000 ft. to less than 4,000 ft. in the Rocky Mountains and in the western edge of the Great Plains. Typically they consist of complexes of stone tools in association with fireplaces, and sometimes ceramics, stone rings and bone debris. The prehistoric occupants are interpreted to be nomads harvesting wild foods according to their seasonal availability. Ethnographic examples include the Ute and Arapahoe tribes. Efforts to examine the nutritional content of wild plant and animal foods have yielded interesting results. Wild onion *(Allium)*, and buffalo meat *(Bison)* data are presented with comments on their availability and prehistoric utilization. The amounts per unit volume of water, protein, and ash are presented. Mineral, trace element and caloric content are indicated where available. Conditions and the effects of preservation are discussed. These foods are evaluated in terms of human minimal daily requirements. Data collection strategy and directions for further research are indicated.

INTRODUCTION

For more than ten years faculty and students at Colorado State University, Fort Collins, have been engaged in archaeological research in north-central Colorado under the direction of Elizabeth Ann Morris. The geographic area involved is the ecotone between the front range of the Rocky Mountains and the high Great Plains of the eastern portion of the state. During the early years of our research our concern was locating and selectively excavating prehistoric sites in this region. We are developing a chronology utilizing radiocarbon dates, stratigraphic depositional occurrence of taxonomically distinct artifact types, and the rare occurrence of historic trade goods. We also are accumulating settlement pattern data, and learning to recognize functionally different site types. Additionally, we hypothesize aspects of the prehistoric life style based on "hard" evidence of the material culture and "soft" inferences from observations on ethnographic peoples. To this end, we have surveyed hundreds of sites and excavated several that promised to be informative with regard to the previously mentioned research goals. Our data consist largely of locational data for the sites, artifacts of stone and rarely other materials, and diverse midden debris including bones of the animals that were eaten.

The reconstructed life style of the people hypothesizes at least 11,000 years of semi-nomadic wandering by nuclear or extended families and probably bands. These groups moved about an area familiar to them, camping by streams and springs, and harvesting seasonally available plant and animal foods. In the warm summer months they would move to the forests and tundra of the mountains to fish and hunt and collect the berries and greens of high altitudes. In the fall they would return to lower elevations and some of them would participate in one or more buffalo hunts. Whether the animals were driven over a cliff or into a man-made or natural trap, large numbers would be eaten on the spot or, importantly, preserved for the cold, lean winter months in the form of jerky or pemmican. The winter months would be spent, by a least many groups, in the dry foothills-plains border in the rain shadow of the Rocky Mountains where snow fell less often than on the western slope or the high plains, and where the warm dry "Chinnok" winds would ameliorate the cold temperatures. The coming of warmer temperatures and the longer days of spring caused greening of the countryside, to the relief of the man and animals alike, and the beginning of a new year's food supply.

In recent years our interest in the details of their subsistence economy has intensified. The animal bones in the trash deposits at archaeological sites are a factual indication of which species were eaten. Bones have not been preserved in all of the sites that we have excavated but where they have been, they have been predominately buffalo *(Bison)* (Kainer 1976; Metcalf 1974; Morris and Kainer 1975; Morris et al. 1979; Ohr et al. 1979; Witkind 1971). There is one notable exception, the Owl Canyon rock shelter where the people ate rabbits almost exclusively (Burgess 1981). Some rabbit bones occur in most sites, as well as other animals such as deer, antelope, and canid. However, deer is second most numerous after buffalo in the bone producing sites. Additionally, the bones in most sites do not represent many diverse animals, but are of these few species suggesting a cultural preference. Apparently, there was often no desire or need to eat other available meat such as porcupine, badger, prairie dog, bear, lion, bobcat or birds. The Packrat Rockshelter (5LR170) is an interesting exception with a very diverse fauna represented (Emslie 1981; Morris et al. 1981). Interestingly, evidence for the cannibalisation of *Homo sapiens* is also absent (Garn and Block 1970; Wurf 1976).

Research on the nutritional content of bison meat has been presented elsewhere (Witkind and Morris In Prep.) and we will present only a brief summary here. Witkind (1971) describes the Roberts buffalo jump and presents the original form of the nutritional content data. Bones in the site represented both adult and immature animals. After a considerable search, a freshly deceased bison was located that had not been fed a supplementary diet. Meat samples from five different muscles of a range-fed 500 lb. bull calf were analyzed for their caloric, protein, and moisture content and for the amount of eight nutritionally important trace elements. These were calcium, phosphorus, sodium, potassium, magnesium, zinc, copper and cobalt.

The samples tested contained 67% to 73% moisture. Drying the meat to make jerky would not only keep it from spoiling but it would reduce its weight by two-thirds to three-quarters. This would be an important consideration for people who carried their supplies or depended on dog travois to move all of the belongings that they did not cache. Only moisture is eliminated in drying; the fat, protein, minerals and trace elements remain. In the five muscles tests, 4-9% of the fresh weight was fat. The fatness of an animal would vary a good deal with season of the year and the richness of its pasture. From 25-29% of the fresh bison meat samples was protein. Clearly, buffalo meat is mostly water and protein. The total caloric content of the samples varied from 83 cal/g in shank meat to 2.14 cal/g in loin meat. The great range reflects the variation in the amount of fat (with its high caloric content) in the individual samples.

DISCUSSION

Almost all of the eight trace elements (calcium, phosphorus, sodium, potassium, magnesium, zinc, copper and cobalt) were present in greater quantities in buffalo hump meat than in the other muscles tested. It is interesting to note that hump meat was so prized by Indians and early white settlers alike on the plains. It not only tasted better, but it was better for them. Additionally, buffalo meat contained much more per unit volume of two trace elements that were tested in common in the onion sample that is discussed below. They are phosphorus and sodium. Copper, zinc, calcium, magnesium and cobalt are apparently present in onions in greater quantities per unit volume than in buffalo meat (Table 2). This may be a sampling error, in which dirt adhering to the plants was included in the analysis.

In summary, if we consider the nutritional content of jerky made from buffalo hump meat, less than one-tenth of a pound of jerky would supply the minimum daily requirements of phosphorus, sodium, potassium, magnesium, zinc and copper. From five- to seven-tenths of a pound would supply enough calcium and 1.2 lbs. would supply enough calories.

In view of the fact that bison bones are so often prevalent in local archaeological sites, it is interesting to compare the amount of meat available from a bison compared to the amount available from other animals. A selected sample indicates that the total weight of buffalo bulls ranges between 1,600-1,800 lbs., and buffalo cows range between 800-900 lbs. A whole bull elk weighed by the Wyoming Game and Fish measured 529 lbs., approximately half the weight of a buffalo cow and a third of the weight of a buffalo bull. Deer and antelope are even smaller.

Wild onions (*Allium* spp.) were selected as an example of a vegetable food available in the mountain-prairie ecotone. Samples were arbitrarily picked because they grew commonly in the site area during the summer of 1980, and because they were easily recognized by the non-botanists on the crew. Ralph Dix, Professor of Botany, designed the sampling procedure and trained Judy Jacobson, historic preservation major, to do the field observations and laboratory analysis. We have no concrete evidence that any of the specific cultures whose remains we recovered ate onions but it seems possible if not likely. In central Wyoming, Frison (1975:396) reports the outside husks of onions covering a rock shelter floor that had a Middle Archaic occupation. Our site, Pack Rat rock shelter, also contains Middle Archaic remains, but we have no perishable items preserved (Morris et al. 1981). Harrington (1967:345) describes onions being used to flavor soups, stews and meats. Eight species of *Allium* are mentioned by Rogers (1980). The bulbs and sometimes leaves of all can be eaten fresh or cooked, and they store well. The juice boiled down to a syrup is good for coughs and colds. *Allium* spp. were collected in spring and early summer by the Gosiute Indians of Utah, but they were not saved for winter use (Chamberlin 1911). Weiner (1972:74) also mentions that the Dakotas and Winnebagos applied crushed onions to insect bites to ease the pain and additionally for a scalp massage, to strengthen the heart and restore sexual potency!

Three species of *Allium* were observed in our study area; *A. textile*, *A. geyeri* and *A. cermuum*. They did not differ in size or the vegetational area where they grew. The nutritional analysis included whole plants of all three species. A plant superficially resembling *Allium* in its flower form and its bulbous root also occurs in the area. This is *Zygadenus*, or Death Camus, containing a deadly poison for which there is no antidote. Students and staff alike became extremely sensitive to the differences between Death Camus and wild onions as the Indians must have been in their time.

The study area was divided into four parts, because preliminary inspection indicated that the differing vegetational cover might effect the frequency of occurrence of onions in each. These areas were grassland (short grass prairie), shrubland, gully, and rocky slope. All four vegetational areas contained some plants in common. Sandy soils varied only slightly from area to area. Differing density of plants, moisture availability and slope varied between the areas and are thought to be major factors affecting the varying dominant vegetation and the onion occurrence.

Thirty 1 m squares were sampled in each of two areas, the shrubland and the grassland. The location of each was determined by throwing a 1 m stick and measuring off a 1x1 m square where it landed. Twenty-five squares on the slope were sampled and 15 squares on the gully floor. The frequency of *Allium* plants per square ranged from a minimum of .26 bulbs in the grassland, to 1.76 plants per square in the shrubland. Total number, partly affected by the differing sample size, ranged from eight in the gully to 214 onions in the shrubland. In summary, *Allium* bulbs were numerous within a few hundred meters of the site, and tended to concentrate in shrubland and slope areas where they were not crowded out by the grasses. Other nonsystematic counts of onion frequency were also made and all observations confirm the high frequency of onions in the area in June 1980.

Onions were removed from five quadrants in each vegetational zone. The bulbs were measured and weighed, with slight differences per zone observed. The average weight of each whole plant was 1.00 g. The average weight per bulb was .39 g. Shrubland and slope areas not only produced many more *Allium* plants, but they were slightly larger bulbs than those in the grassland and gully areas.

In an effort to determine the nutritional content of *Allium* a sample of whole onion plants was sent to the Raltech Scientific Service in Madison, Wisconsin. The results were presented in terms of g/100 g or, they can be thought of as percentages of any volume or amount.

Moisture	67.9 g/100 g (or %)
Protein	2.2 g or %
Fat	0.4 g or %
Ash	2.6 g or %
Crude fiber	6.1 g or %
Carbohydrates	20.8 g or %

There were 95.6 cal/100 g of onions, or remembering that the average weight per fresh onion plant was 1 g—each plant would have .956 cal, as well as minute amounts of fat, protein and ash. Any size of fresh onion sample would be just over two-thirds water.

The ash was analyzed for its content of the following important nutritional elements: Calcium, Phosphorus, Potassium, Magnesium, Sodium, Aluminum, Barium, Iron, Strontium, Boron, Copper, Zinc, Manganese and Chromium. The results were:

	Mg per onion (Average wt. = 1 g)	Mg/100 g onions
Calcium	4.3770	437.70
Phosphorus	0.3096	30.96
Potassium	2.7200	272.00
Magnesium	0.4423	44.23
Sodium	<0.1500	<15.00
Aluminum	0.1259	12.59
Barium	0.0246	2.46
Iron	0.0850	8.50
Strontium	0.0030	0.30
Baron	0.0035	0.35
Copper	0.0872	8.72
Zinc	0.0523	5.23
Manganese	0.0114	1.14
Chromium	0.0014	0.14

In the interests of learning what wild onions would contribute to the Minimum Daily Nutritional Requirement for humans, Table 1 was compiled. The MDR figures are for both sexes and for individuals at least one year old. It must be remembered that the MDR figures were computed in the United States. Other nations, including even Canada, have computed different figures for some of these and other nutritional components. Furthermore, it has been widely suggested that peoples of different ethnic backgrounds

Table 1.—*Minimum Daily Requirement of calories and selected elements and minerals required by humans of at least one year of age. Average computed weight of one onion equals one gram. MDR figures are for the U.S.*

Element	Minimum Daily Requirement	Amount in 1 g	Amount in 100 g
Calcium	800-1200 mg	4.3770 mg	437.70 mg
Phosphorus	800-1200 mg	.3096 mg	30.96 mg
Potassium	550-5625 mg	2.7200 mg	272.00 mg
Magnesium	150-450 mg	.4423 mg	44.23 mg
Sodium	325-3300 mg	< .1500 mg	15.00 mg
Aluminum	No figures	.1259 mg	12.59 mg
Barium	No figures	.0246 mg	2.46 mg
Iron	10-18 mg	.0850 mg	8.50 mg
Strontium	No figures	.0030 mg	.30 mg
Boron	No figures	.0035 mg	.35 mg
Copper	1.0-2.5 mg	.0872 mg	8.72 mg
Manganese	1.3 mg	.0114 mg	1.14 mg
Zinc	10-25 mg	.0523 mg	5.23 mg
Chromium	.02-.20 mg	.0014 mg	.14 mg
Calories	2400	.9560	95.6

may have different minimum daily nutritional requirements. The daily total energy requirement would be greater in any case. However, keeping these possibilities in mind, the figures are presented in Table 1 as a point of reference.

It may seem that even if 100 g of fresh wild onions consisting of an average of 100 onion plants, only the MDR of copper and for some people chromium and manganese would be met. However, substantial amounts of the MDR for calcium, zinc, potassium, and iron would be consumed and useful amounts of magnesium as well. Useful amounts of the minimum daily caloric requirement would be taken. Onions contain so little phosphorus and sodium that they provide negligible contributions of these nutrients. Onions would be good for people who needed a low sodium diet. In summary, collectable amounts of wild onions contain significant portions of eight important dietary elements but very small portions of phosphorus, sodium, protein, fat, and calories. An aboriginal group dependent upon eating wild onions alone would have a mostly deficient diet. Eaten in large quantities the nutritive intake would improve slightly but the resource would quickly be exhausted in any given area.

Analysis of vitamin C content in wild onions is not included in our analysis at this time. However, the U.S. Bureau of Agriculture Handbook 8 lists the ascorbic acid content of commercially grown raw onions and whole raw onion plants as ranging from 42 to 138 mg/100 g (Watt and Merrill 1975). Meats generally contain no Vitamin C and this no doubt would have given added appeal for onions to an aboriginal tribal diet in the spring.

If we compare the nutritional value of wild onions to that of buffalo meat, interesting and not entirely unexpected results emerge (Table 2).

TABLE 2.– *Comparison of the nutritive value per 100 g sample of fresh wild onion and buffalo hump meat. With the exception of the calories, figures may be read as g/100 g, or %.*

Ingredient	Wild Onions	Buffalo Hump Meat
Calories	95.60	138.00
Moisture	67.90 g	67.00 g
Protein	2.20 g	25.00 g
Fat	.40 g	5.00 g
Calcium	437.70 mg	2.60 mg
Phosphorus	30.96 mg	399.00 mg
Potassium	272.00 mg	33.50 mg
Magnesium	44.23 mg	17.00 mg
Sodium	15.00 mg	76.50 mg
Aluminum	12.59 mg	– – –
Barium	2.46 mg	– – –
Iron	8.50 mg	– – –
Strontium	.30 mg	– – –
Boron	.35 mg	– – –
Copper	8.72 mg	.60 mg
Manganese	1.14 mg	– – –
Zinc	5.23 mg	2.50 mg
Chromium	.14 mg	– – –
Cobalt	– – –	1.20 mg

Buffalo hump meat compared to an equivalent weight of wild onions has about the same amount of moisture, much more protein and fat and half again as many calories. Considering comparable measurements of the minerals and trace elements, bison meat contains more phosphorus and sodium than does wild onion, and less calcium, potassium, magnesium, copper and zinc. A diet featuring buffalo meat flavored with onions would supply a high proportion of basic nutritional requirements.

Table 3 is a selected list of wild foods with their nutritive values as published by the U.S. Bureau of Agriculture (Adams 1975; Watt and Merrill 1975). The items were selected by us for being in the natural undomesticated, unfertilized state but we cannot be positive of this. Some of the results are interesting indeed and offer useful suggestions for direction for future research.

We are interested in pursuing these aboriginal nutritional studies. Some floral data is available already such as the nutritive value of prickly pear cactus, pinyon nuts, yucca plants and numerous wild fruits (Watt and Merrill 1975). Certain other wild animals besides bison have been measured, at least once. Examples are muskrat, beaver, rabbit and caribou. Obvious directions for future research are to assess the quantities available and nutritive value of local plants that appear frequently in the ethnographic if not the archaeological record. Ponderosa Pine *(Pinus ponderosa)* tree products, Prairie morning glory root *(Ipomea* spp.), Indian rice grass *(Oryzopsis hymenoides)* seed, Skunkbush sumac *(Rhus trilobata)* and wild plums *(Prunus americana)* are easily available. Using buffalo meat and wild onions as initial studies we expect an interesting, and rewarding class of information to emerge in the future.

TABLE 3.—*Nutritive values of selected foods. Data is presumed to represent native foods without modern soil or fertilizer enrichment, but this was not controlled in the sampling (Adams 1975; Watt and Merrill 1975).*

Food, approximate measures, units and weight		Values for edible part of foods									
		Water	Food energy	Protein	Fat	Carbo-hydrate	(Ca)	(P)	(Fe)	(Na)	(K)
	Grams	%	Calories	g	g	mg	mg	mg	mg	mg	mg
Amaranth, raw leaves - 1 lb.	454	86.9	163	15.9	2.3	29.5	1211	304	17.7	—	1864
Bamboo shoots, raw, cut into pieces of 1-in. length - 1 lb.	454	91.0	122	11.8	1.4	23.6	59	268	2.3	—	2418
Beaver, cooked (roasted) - 1 lb.	454	56.2	1125	132.5	62.1	0.0	—	—	—	—	—
Beechnuts-shelled - 1 lb.	454	6.6	2576	88.0	226.8	92.1	—	—	—	—	—
Crayfish, freshwater	100	82.5	72	14.6	.5	1.2	77	201	1.5	—	—
Duck, flesh only	100	70.8	138	21.3	5.2	0.0	—	—	—	—	—
Groundcherries (poha or cape-gooseberries), raw, without husks - 1 lb.	454	85.4	240	8.6	3.2	50.8	41	181	4.5	—	—
Mushrooms, raw - 1 lb.	454	89.1	159	8.6	2.7	29.5	59	440	6.4	45	1701
Muskrat, cooked, roasted	100	67.3	153	27.2	4.1	0.0	—	—	—	—	—
Pinenuts: Pinon, shelled - 1 oz.	28	3.1	180	3.7	17.2	5.8	3	171	1.5	—	—
Pricklypears, raw	100	88.0	42	.5	.1	10.9	20	28	.3	2	166
Quail, raw, giblets	100	63.0	176	21.8	6.2	6.7	—	—	—	—	—
Rabbit, wild: flesh only, raw	100	73.0	135	21.0	5.0	0.0	—	—	—	—	—
Raccoon, cooked, roasted	100	54.8	255	29.2	14.5	0.0	—	—	—	—	—
Snail, raw	100	79.2	90	16.1	1.4	2.0	—	—	3.5	—	—
Trout, brook, raw	100	77.7	101	19.2	2.1	0.0	—	266	—	—	—
Trout, rainbow or steelhead, raw	100	66.3	195	21.5	11.4	0.0	—	—	—	—	—
Turtle, green, raw	100	78.5	89	19.8	.5	0.0	—	—	—	—	—
Venison, lean meat only, raw	100	74.0	126	21.0	4.0	0.0	10	249	—	—	—

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