Food habits of the guanaco (**Lama guanicoe**) of Tierra del Fuego, Chile*

KENNETH J RAEDEKE**

COMPENDIO

Muestras del rumen fueron colectadas sistemáticamente de 24 guanacos (Lama guanicoe) *de Isla Grande, Tierra del Fuego, Chile, durante el período 1972 a 1975 El material de las muestras fue separado por especie, y el volumen de cada especie fue determinado La siguiente fue la dieta promedio anual 61,5% pastos; 15,4% ramas de árboles y arbustos; 6,9% epifitos, 2,4% líquenes; 2,6% hongos; y 11,2% hierbas El uso estacional coincidió con el desarrollo y disponibilidad de las varias especies Los índices de selectividad sugieren que hierbas, líquenes y epífitos fueron los más preferidos, seguidos por los pastos Arboles y arbustos fueron seleccionados negativamente en todas las estaciones*

Introduction

THE guanaco *(Lama guanicoe)* is widely distributed on the pampas and parklands of Patagonia While their numbers have declined drastically in the past few decades (10, 14) they are still an important component of the fauna of the range ecosystem Recent studies have shown that the dramatic decline of the guanaco in southern South America is caused by the reduction in forage availability since the introduction of domestic sheep (15) For this reason, it is imperative to have a better understanding of the forage needs of the guanaco if we are to prevent a further decline in the distribution and abundance of the guanaco population The purpose of this paper is to present baseline data on the food habits of the guanaco

The field studies described in this paper were conducted by the author from 1972 to 1975 This work is a part of the wildlife research program of the Corporación Nacional Forestal of Chile, and additional support was provided by the United States Peace Corps, and the World Wildlife Fund Grant 879 The Instituto de la Patagonia and the Servicio Agrícola y Ganadero made their laboratory facilities available for use in the study

The study area

All materials included in the analysis were collected from the central region of Isla Grande in the area between 69 and 70 degress west longitude and 53 and 54 degrees south latitude This area is within the Rio Grande river basin, at the interface of the continuous beech forest along the foot of the precordillera on the south, and the open steppe grasslands on the north The habitat consists of a mosaic of plant communities including beech forests, matorral shrubs lands, sphagnum bogs, and the steppe grasslands The tree species include nirre *(Nothofagus antarctica)* and lenga *(Nothofagus pumilio)*, both of which are deciduous The principal shrubs are michay *(Berberis ilicifolia)*, calafate *(Berberis buxifolia)*, and romerrillo *(Chiliotrichium diffusum)* The latter shrub is a common increaser in the matorral and grassland communities The dominant grasses are coiron *(Festuca gracillima, Festuca pallescens,* and *Festuca magellanica)* and various species of the genera *Stipa, Deschampsia,* and *Poa* Common herbaceous plants belong to the genera *Ranunculus, Acaena, Senecio* and others More detailed descriptions of the flora of the region are given by Auer (1), Humphrey *et al* (4), and Pisano (12, 13)

The study area ranged in elevation from 200 to 400 meters The topography is characterized by rolling hills and plains disected by numerous small streams and rivers Large lakes fill the glacier scoured valleys of the precordillera hills on the south The entire area is grazed by sheep, domestic cattle, and horses In 1975, the suday area of 200,000 hectares supported a herd of 140,000 sheep

The climate is characterized by cool dry summers, and rain and snow in the winters The mean annual precipitation is 300 to 450 mm The growing season is too short to allow cultivated crops to ripen, except in areas with favorable microclimates

* Received for publication August 29th 1980.
** College of Forest Resources AR-10, University of Washington, Seattle, Washington 98195 U S A

Materials and Methods

Rumen samples were collected from free-ranging guanacos on the study area. A total of 24 samples were collected, representing all months except January, February, and July. An attempt was made to systematically collect a representative sample from all sex and age classes in the population.

A one liter sample of rumen material was collected from each guanaco sampled. The rumen was throughly mixed before taking the sample. The samples were covered with a 10% formalin solution until analyzed.

The analysis of the rumen samples followed the methods described by Nellis (9). To separate the plant fragments, the rumen sample was washed with fresh water over a gang of sieves for several minutes. Plant material that remained on the 6.35 sieve was saved. This plant material was separated by species, and identified by comparison to a reference plant collection. The reference collection, and all forbs, grasses, and other questionable material in the sample was identified by Edmundo Pisano, botanist of the Instituto de la Patagonia, Punta Arenas, Chile. A binocular microscope was used as necessary, the amount of each plant species separated in the rumen sample was determined by volumetric displacement. All averages were calculated by the aggregate percentage method of Martin *et al.* (8).

Results

The results are summarized by sample in Table 1, and by month in Figure 1. In both cases, the plant species have been combined into the plant life forms of grasses (including grass-likes), browse, epiphytes, lichens, fungi, and forbs. The season of the year in which the sample was collected and the season of use of that sample area by sheep is given in the table. The actual plant species identified in the rumen samples, and the percentage of the samples in which they were identified, are given in Table 2.

Forty plant species were identified in the samples. With the exception of the grasses, and some succulent forbs, the majority of the species were readily identifiable. However, less than 10 per cent of the grass and grass-like material was identified to species, so it seems

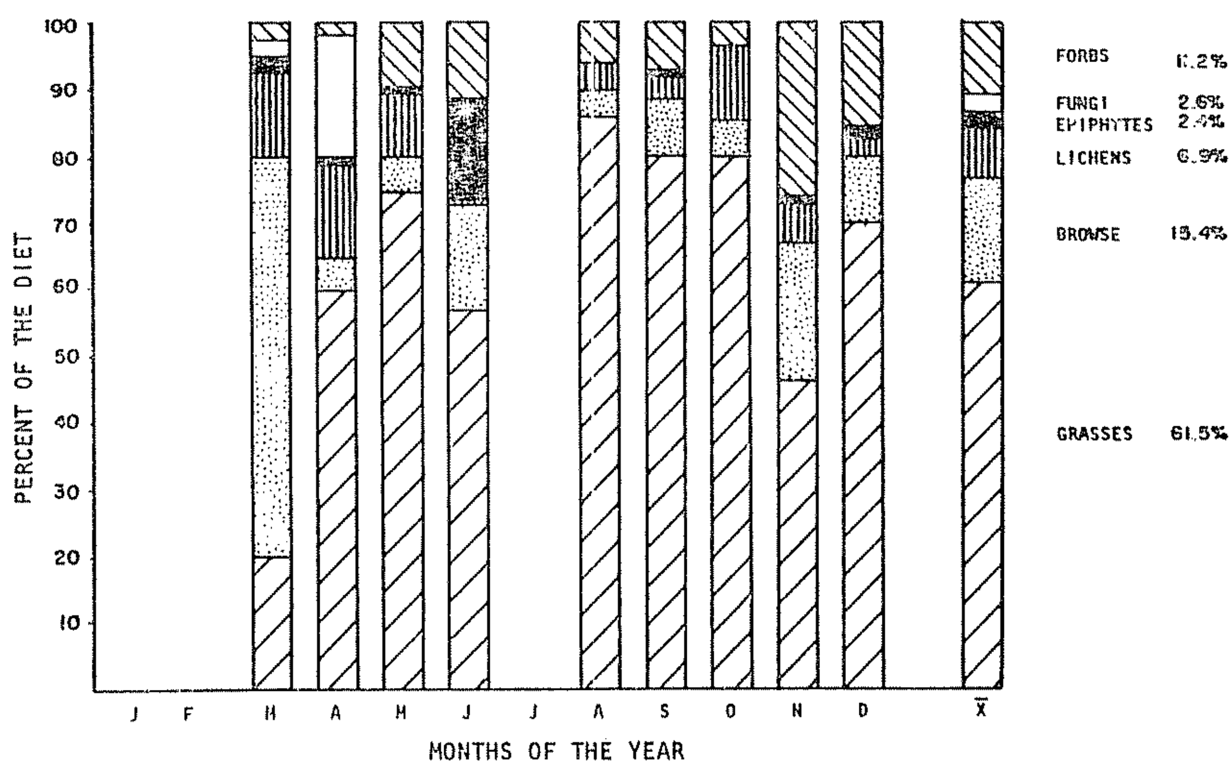

Fig. 1.—*The monthly and average annual food habits of the guanaco of Isla Grande, Chile, based on the analysis of rumen samples.*

likely that some grass species were eaten but not identified in the samples. Furthermore, if all the grass material had been identified to species, the percentage of occurrence of the different species would most likely have increased.

In general, the consumption of any forage species was closely related to its phenology and availability. Guanacos ate browse and forbs when they were at their peak in abundance and most palatable in the spring and early summer. The fungi, lichens, and epiphytes were eaten in the fall when they were most readily available. In apparent contrast to this general

Table 1.—Food habits of the guanaco of the study area, as determined by rumen analysis. The table values are percent of the total sample. The range types listed are: W = winter; S = summer.

Number	Month Year	Range type	Season	Grass & grasslike	Browse	Lichens	Epiphytes	Forbs	Fungi
G7	3/73	S	S	2.4	95.2	1.3	—	1.1	—
G8	3/73	W	S	37.9	24.3	2.2	25.7	4.8	8.9
G9	4/73	W	S	37.8	8.0	0.2	13.7	2.5	37.8
G10	4/73	W	S	82.5	2.1	0.5	11.5	3.7	—
G14	5/74	W	S	75.3	4.0	0.4	10.0	10.2	0.1
G15	6/74	S	W	76.1	14.9	5.4	0.2	3.3	—
G16	6/74	S	W	54.1	16.2	3.8	tr	25.4	—
G17	6/74	S	W	42.2	15.6	37.5	0.6	4.0	—
G1	8/72	W	W	89.2	1.6	tr	2.5	6.7	—
G3	8/72	W	W	82.2	9.7	tr	tr	7.4	—
G11	8/73	W	W	64.6	7.8	tr	20.4	7.2	—
G12	8/73	W	W	91.0	2.8	—	—	6.1	—
G13	8/73	W	W	96.5	3.8	tr	tr	3.1	—
G2	9/72	S	W	79.3	10.3	0.5	2.4	7.4	—
G18	10/74	W	W	54.2	10.8	—	34.4	1.6	—
G19	10/74	W	W	93.2	2.1	—	tr	4.7	—
G20	10/74	S	W	91.0	4.5	tr	1.9	2.0	—
G4	11/72	S	W	49.9	30.1	1.2	1.0	17.6	—
G5	11/72	W	W	26.7	5.0	0.9	10.0	57.4	—
G21	11/74	W	W	63.7	29.4	tr	4.9	1.9	—
G6	12/72	W	W	58.8	30.5	10.7	2.9	5.1	—
G22	12/74	W	W	58.9	3.7	tr	0.4	36.3	—
G23	12/74	S	S	59.4	3.0	tr	tr	37.6	—
G24	12/74	S	S	75.7	5.8	tr	5.4	13.2	—

Table 2.—Plant specits, with percent of occurrence, in the diet of guanacos of the study area on Isla Grande, Chile.

Common Spanish Name	Scientific Name	Frecuency (%)
Tree Species:		
Nire	Nothofagus antarctica	100
Lenga	Nothofagus pumilio	50
Coigue	Nothofagus betuloides	4
Shrub Species:		
Calafate comun	Berberis buxifolia	96
Romerillo	Chiliotrichium diffusum	50
Michay	Berberis ilicifolia	42
Murtilla	Espetrum rubrum	29
Mata gris	Senecio patagonicus	13
Mata verde	Baccharis patagonica	8
Calafate enano	Berberis empertrifolia	4
Chaura	Pernettya mucronata	4
—	Berberis heterophylla	4
Epiphyte Species:		
Clavel de viento	Mesodendrum punctulatum	100
Fern Species:		
—	Blechnum penna-marina	25
Fungi Species		
Dihuenes	Cyttraia darwinii	29
Lichen Species:		
Barbara del viento	Usnea spp	75
Grass and Grasslike Species:		
Junquilla	Marsipperumum grandiflorum	38
Festuca or coiron	Festuca gracillima	38
—	Deschampsia antarctica	18
Festuca	Poa pratensis	13
—	Agrostis spp.	8
—	Carex decidua	8
—	Festuca magellanica	8
—	Geum magellanica	4
—	Carex sp	4
Forb epecies		
Chicoria	Taraxacum officinale	37
Cadillo	Acaena magellanica	21
—	Codonorchis lessonii	21
Cadillo	Acaena pinnatifida	17
Vinagrillo	Rumex acetose-la	17
Bolsita del pastor	Capsella bursa-pastoris	13
—	Phleum alpinum	12
Cadillo	Acaena ovalifolia	8
Mogote	Azorella trifucata	8
—	Ranunculus peduncularis	8
Fruta del diablo	Gunnera magellanica	4
Flor de la estrella	Perezia recurvata	4
—	Colobanthus subulatus	4
—	Senecio acanthyfolius	4
—	Osmorrhiza obtusa	4

rule, grasses were eaten least in spring and early summer when at their peak of new growth and abundance.

Seasonal Patterns in Forage Consumption

The principal food of the guanaco was the grass of the pampa. Approximately 60 per cent of the annual diet consisted of grass and grass-likes. In December and January at the beginning of summer, grasses made up about 60 per cent of the diet, but during the late summer months, the grass consumption declined to less than 20 per cent by March. Grass use increased to its maximum of 85 per cent of the diet in winter (July to October). From late winter through spring the percentage of the grass in the diet declined gradually with a concurrent increase in the consumption of forbs and browse.

Nine grass species were identified in the rumen samples. The most important grasses, on the basis of frequency of occurence in the samples, were the "coiron" or festuca bunch grasses (*Festuca gracillima*, and *Festuca magellanica*). These species were identified in 40 per cent of the samples.

The second most important component of the diet was the browse, from both trees and shrubs. This forage class constituted 15.4 per cent of the total annual diet. The consumption of browse was highest in the spring and summer when the deciduous trees had leafed out, and many of the shrubs were flowering. The lowest consumption of browse was in the winter when the trees has lost their leaves. The winter browse consumption consisted of almost entirely evergreen shrubs such as *Berberis buxifolia, Berberis illicifolia*, and *Chiliotrichium diffusum*. The first two species are highly palatable to both sheep and guanacos. But the latter, an increaser on the range, is not palatable to sheep, but is eaten by guanacos. Overall, nirre was the most important browse species, both in terms of volume consumed, and frequency of occurence in the samples. Nirre is also the most abundant browse species due to its extensive occurence in the area, and low growth form. All three trees of the *Nothofagus* genus occuring on the study area were identified in the rumen samples.

The third most important component of the diet was the tree-born epiphytes, lichens, and fungi. The consumption of these plants paralleled that of the browse group, being high in the summer and low in the winter. The seasonal percentage in the diet varied little, from 8 per cent to 14 per cent. The most important species were the mistletoe, *Mesodendrum punctulatum*, and the lichens of the genus *Usnea*. All three of these forage types were eaten as the guanaco browsed in the tree crown, and as windfall. The fungi were important only in the fall, at the end of their normal growth cycle, when they had fallen to the ground. Due to their extremely high digestibility and high water content, both the fungi and the lichens would tend to be underestimated in the analysis of the rumen contents and in fecal analysis.

Forbs were eaten throughout the year; however, they were important in the diet only in the spring months. This consumption reflects the greater abundance and availability in the spring. In general, the grasslands of Patagonia are not productive forb ranges. The only forb species important in the rumen samples was the common dandelion, *Taraxacum officinale*.

Forage Preferences

Forage preference or selectivity indices show what an animal would prefer to eat if all plants had the same availability. Range scientists use preference indices that are calculated as the ratio of the amount of the species consumed to the availability of the species on the range (17). A more general measurement is Ivlev's (5) selectivity index (E), calculated as:

$$E(i) = (ri - Pi)/(ri + Pi)$$

where *ri* is the amount consumed, and *Pi* is the availability of the plant in the environment. A negative value indicates selection against the plant in the diet, and a positive values indicates selection for the plant in the diet. The index is a relative value, varying from positive one to negative one.

As the information on the availabilities of the different plants is limited, a comparison will be made only between the life forms classes. In Table 3 the consumption rates, availability, and Ivlev's selectivity indices are given for the life form classes of browse, grass and grass-likes, forbs, and the miscellaneous plants (lichens, epiphytes, and fungi). The consumption rates are from the pooled rumen samples, and the availability is an estimate of the percent standing biomass for each forage class based on the total ground cover and limited vegetation sampling [see Raedeke (15) for a description of the estimation procedures].

Table 3.—Annual dietary preferences of guanacos based on rumen analysis data. The tabled values are Ivlev's (5) selectivity coefficient, E(i).

Forage Class	Consumption (% of diet)	Availability (% biomass)	Ivlev's E
Grass and Grass-likes	61.5	60.0	+0.012
Browse	15.4	30.0	—0.322
Forbs	11.2	5.0	+0.382
Lichens, epiphytes and fungi	13.9	5.0	+0.471

The results show that while the grasses are the major components of the diet, they are consumed almost in the same proportions as they are encountered in the environment. The grass are neither highly preferred nor highly selected against The forbs and the other miscellaneous plant species (lichens, fungi, and epithytes) are the most highly preferred, and have the lowest availability. Browse is the least preferred, and is probably eaten only when the other plants are not available, or to optimize the individual guanacos mix of nutrients in the diet.

Feeding trials with captive guanacos also showed that the forbs and epiphytes were most highly preferred In smorgasboard type trials, the forbs and epiphytes were eaten first, and the other plants were eaten only when the forbs and epiphytes had been completely consumed The most preferred browse species were the *Berberis* species, and other flowering shrubs Lenga and nirre were eaten last.

Discussion

The results of the present study suggest that the guanaco is a generalist herbivore, adapted to utilize a broad range of forage types This lack of dietary specialization is prcb:bly the result of the evolution of the guanaco species without any major herbivore competitors. From the end of the Pleistocene until the introduction of sheep and other domestic stock, the guanaco had been the only ungulate of the Patagonian grasslands (16) Without competitors, the guanaco occupied a wide range of habitats and utilized most forage types. The specialization of ungulates diets and "niches" in the face of competition is well documented for the savannahs of Africa (2, 6), and for the range lands of North America (3, 7, 11). Without the competitive pressures, the guanaco remained a generalist.

A second hypothesis is that the generalist nature of the guanaco diet is in part a response to the recent increase in competition with domestic sheep. Raedeke (15) observed a shift in the guanaco diet during periods of intense competition with sheep. A shift was not observed when the range and forage resource was not shared with sheep When sheep were not present, the guanacos were principally grazers, and when sheep were present, the guanaco shifted to a diet of mainly browse and other non-grass plants While the results of the present study are not conclusive, they also suggest a shift in diet composition during periods of competition with sheep (see Table 1, samples G5, G6, G7, G21, G22 and G23). Larger samples size is necessary before positive conclusions can be made.

Summary

Twenty-four rumen samples were systematically collected from free-ranging guanacos *(Lama guanicoe)* on Isla Grande, Tierra del Fuego, Chile, during the period 1972-1975 All material in the rumen samples was separated to species, and the total volume of each species identified in the rumen sample was calculated. The average annual diet was the following: Grass and grass-likes, 61 5%; Browse 15 4%; Epiphytes 6 9%; Lichens 2 4%; Fungi 2 6%; and Forbs 11 2%. Seasonal patterns paralleled the development of new growth and availability Selectivity indices suggest that forbs, lichens, epiphytes, and fungi were the most preferred, followed by the grass and grass-likes. Browse was negatively selected in all season

Literature cited

1 AUER, V. The Pleistocene of Fuego-Patagonia. Part II: The History of the Flora and Vegetation Geologica-Geographica 50:1-239 1958

2 BELL, R. Grazing ecosystem in the Serengeti Scientific American 225: 86-93 1971

3. BUECHNER, H Regulation of numbers of pronghorn antelope in relation to land use Terre et la Vie 108: 266-285 1961.

4 HUMPHREY, P, BRIDGES, D., REYNOLDS, P., and PETERSON, R Birds of Tierra del Fuego Prelim Smithsonian manual. Washington D. C 1970.

5 IVLEV, V. Experimental Feeding. Ecology of Fishes New Haven, Conn. Yale University Press. 1961.

6. LAMPREY, H. Ecological separation of the large mammal species of the Taragire Game Reserve, Tanganyika. East African Wildlife Journal 1: 63-92. 1963

7. MACKIE, R. Range ecology and relations of mule deer, elk, and cattle in the Missour River Breaks, Montana. Wildlife Monographs 20: 1-79. 1970.

8 MARTIN, A, GENSCH, R. and BROWN, C. Alternate methods in upland gamebird food analysis. Journal of Wildlife Management 10: 8-12. 1946

9 NELLIS, C. The mule deer of the National Bison Range: population dynamics, food habits, and physical condition. M S Thesis Missoula, Montana Montana State Univ., 1962.

10 NUEVO, C. Situación del guanaco en la República Argentina. Proc 2nd Conf South American Camels. Puno, Perú 1975 (in press).

11. OLSEN, F, and HANSEN R. Food relations of free-ranging horses to livestock and big game, Red Desert, Wyoming Journal of Range Management 30:17-20. 1977.

12 PISANO, E. La vida en los Parques Nacionales de Magallanes. Punta Arenas, Chile, Instituto de la Patagonia. Monografía Nº 6. 1973.

13 PISANO, E Estudio ecológico de la región continental sur del área Andino-Patagónica Annales de la Instituto de la Patagonia 5:59-104. 1974.

14 RAEDEKE, K. El Guanaco de Magallanes, Chile Su Distribución y Biología Santiago, Chile, Corporación Nacional Forestal, Publicación Técnica Nº 4. 1978.

15 RAEDEKE, K Population dynamics and socioecology of the guanaco *(Lama guanicoe)* of Magallanes, Chile PhD Thesis University of Washington, Seattle 1979.

16 SIMPSON, G. History of the fauna of Latin America. American Scientist 38: 361-389. 1950.

17 STODDART, L., SMITH, A, and BAX T. Range Management. New York, McGraw-Hill, 1975.

Desarrollo rural en Corea del Sur

Corea del Sur es uno de los países de Asia que, en forma sorprendente, está llegando a formar las filas de los países desarrollados Este fenómeno lo hemos comentado en *Turrialba* (vol 29 p 9, 1979) analizando sus causas y características Los otros son Taiwan, Hong Kong y Singapur Recientemente, se han dado a conocer algunas cifras sobre el sector rural derivados del progreso operado (*The Economist*, May 17, p 40, 1980)

Durante los novecientos setenta, el promedio del ingreso familiar en las villas rurales de Corea del Sur se elevó desde unos US$ 800 a casi $ 3 000 por año Ahora, todos tienen bastante que comer, hasta en lo que era antes la época de hambre precosecha. Todos los niños de las villas van a la escuela primaria; 80 por ciento van a los colegios secundarios y una pequeña proporción pasan los exámenes para unirse a los 278 000 estudiantes en las universidades Si se enferma, el aldeano toma antibióticos o ve a un médico Cada familia tiene televisión y un radio tocacasette Los salarios diarios en el campo, de US$ 8 a 10, más alimentos, licor de arroz y cigarrillos, son tan buenos o mejor que los que un obrero no calificado gana en la ciudad

Casi todos los agricultores tienen una vaca o un buey pero existen casi 200.000 cultivadores a motor que están halando, arando, surcando y cosechando cuatro veces más rápido En esta primavera, hombres y mujeres están adiestrándose para manejar transplantadores mecánicos de arroz, introducidos recientemente del Japón Las bombas de agua de propiedad de cada familia han reemplazado las tradicionales ruedas de agua Los almácigos de arroz y las hortalizas se cultivan ahora en invernaderos de vinilo resistentes al frío

Esta sorprendente transformación agrícola de los últimos diez años proviene en su mayor parte de la exitosa adopción en Corea del Sur, en los novecientos setenta, de las nuevas variedades enanas de arroz de altos rendimientos, (Cf *Turrialba* 19: 445 1969). En 1977, Corea del Sur alcanzó el más alto rendimiento promedio del mundo, al producir 4900 kilogramos de arroz pulido por hectárea Su establecimiento de ciencia agrícola, dominada por PhD graduados en los Estados Unidos, se puede comparar al del Japón Esta tecnología, más un precio de sostenimiento del arroz que es el doble del de 1970 y una expansión rápida del transporte y del mercado urbano, constituye la base del cambio operado

Los lugareños han recibido desde el principio exhortaciones para crear su *saemaul* (nueva comunidad). Con el lema, al estilo confuciano, "autogestión, cooperación y diligencia", se les estimulaba a construir caminos puentes y pozos y, más espectacularmente, reemplazar sus viejos techos de paja, por techos de tejas o metal, brillantemente pintados, que han cambiado completamente la apariencia de la campiña. Después de un tiempo, este movimiento se ha transformado en una mística que es elogiada en todas las esferas, al mostrar que una vez que los aldeanos consiguen capital, tecnología, y acceso a los mercados, se pueden conseguir notables resultados

Hay también algunos cambios en las costumbres: los hombres y las mujeres se pueden sentar juntos; el hijo de un carnicero puede aspirar a ir a la universidad El alfabetismo general, la tenencia equitativa de la tierra y de los ingresos, y una actitud vivaz hacia la política hacen que una aldea surcoreana sea tan libre y abierta como cualquiera de Asia

Con la primavera vuelven las golondrinas a los campos de Corea del Sur, lo que para los campesinos es un buen augurio En las últimas dos semanas de mayo, la mayor parte de los estudiantes y trabajadores vuelven también a sus aldeas de origen, de escasa mano de obra, para ayudar a la gente mayor que ahora maneja la mayor parte de la agricultura de Corea del Sur, lo que también es una característica de las sociedades en la etapa de despegue en su desarrollo

Tumor vegetal alimenta a bacteria que lo origina

Los ingenieros genéticos están considerando seriamente como podrían seguir el ejemplo de una ingeniosa bacteria que ha descubierto la forma de que las células vegetales produzcan cantidades copiosas de los nutrimentos que requieren El microorganismo, *Agrobacterium tumefaciens*, debe haber hecho el descubrimiento hace tiempo, porque su efecto sobre la planta es producir el tumor vegetal conocido como agalla del cuello, la primera de cuyas descripciones se atribuye a Aristóteles En una discusión algo más reciente sobre tumores de la agalla del cuello, Martin Drummond en *Nature* (vol 281, p 342) explica lo que el tumor hace por la bacteria

Los biólogos moleculares han mostrado recientemente que la bacteria causa el tumor al transferir información genética a la planta Esta información está contenida en un plasmidio, una clase de DNA extracromosomal que se duplica a sí mismo y que ha alcanzado recientemente el estrellato al ser explotado como el vector de DNA foráneo en la ingeniería genética Los plasmidios acarreados por el *A. tumefaciens* transfieren a las células de la planta infectada dos pedazos de información Uno domina a los mecanismos de control del crecimiento de la célula (de allí el tumor); y el otro enseña la síntesis de octopina o de nopalina, de las que se nutre la bacteria

¿Cómo, se pregunta Drummond, pueden los humanos explotar este sistema para aumentar la producción de nutrimentos sobre los cuáles *ellos* se nutren? Lo que tiene en mente es la posibilidad de insertar en los plasmidios genes para la fijación de nitrógeno que permita a las plantas cultivadas no depender de fertilizantes nitrogenados, o modificar a genes de la misma planta, alterados para mejorar la calidad nutritiva de la proteína vegetal El plasmidio transferiría los genes a las células vegetales

Este procedimiento podría también causar un tumor a la planta, pero afortunadamente este efecto es reversible Muchos tumores de agalla del cuello retienen cierta capacidad para transformarse en tejidos vegetales normales, que se manifiestan como tallos embrionarios en la superficie del tumor Si uno de estos tallos se injerta a una planta normal, crece y se desarrolla en tejido vegetal normal, pero sin perder su capacidad de sintetizar los productos codificados por el plasmidio

Así que puede ser posible usar los plasmidios para transferir genes a plantas efectivamente normales Los problemos técnicos que se deben resolver son enormes Pero, entonces, también lo son las posibilidades

Publicaciones

Boletín Informativo del S I N El Sistema de Información de Nutrición (S I N) de Costa Rica ha iniciado en enero de 1980 una publicación mensual, *Boletín Informativo del S.I N*, cuyo principal objetivo es la difusión de las investigaciones y estudios realizados por SIN Los artículos que se presentan son una síntesis de los programas que se están desarrollando Sin embargo, publicará también artículos relacionados con la nutrición El primer número tiene (de un total de cinco) artículos sobre aplicación del indicador talla/edad en estudios sobre nutrición, sobre sistemas de información de poblaciones rurales y urbanas; sobre la encuesta nacional de nutrición de 1978 El segundo número tiene un trabajo de Guillermo Chaverri Jiménez sobre "Disponibilidad de granos básicos en Costa Rica y sus implicaciones nutricionales, 1971-1978".

El editor es Mario Orlando Sánchez Gómez y la dirección es Oficina de Información de la Casa Presidencial, Apartado 10089, San José, Costa Rica