What Are You Eating?
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Cover design and photo by Karen Lazarus.
It is timely for UTAH SCIENCE to focus attention on nutrition in the Bicentennial year. To improve the diet of many and to provide adequate caloric intakes for the less fortunate are major international issues. There is no more important goal at Utah State University, as elsewhere, than to design agricultural production to meet the specific food needs of people in Utah and around the world.

But who is to define those needs: In the more affluent nations, with limited experimental evidence, pressures are mounting to install a public “nutrition policy,” presumably to reduce the risk of coronary heart disease. More than 50 percent of the male population in these nations will die with some cardiovascular ailments, and it has been argued that diet is an important element in management of cardiovascular disease. Certainly people at risk can improve their outlook by altering their eating habits, but this is hardly reason for a major qualitative national dietary change.

To be sure, in most Western nations, over-consumption of foods is a relatively general problem. Since the turn of the century we have in the United States increased our consumption of fat largely from vegetable sources from 35 percent to 45 percent of the calories we consume. Fats are a concentrated source of calories, therefore the advantage of reducing fat intake in populations where excess food energy is consumed becomes obvious. This is not justification, however, for changing national agricultural policy to determine the kind of food that should be produced.

Public Concern is Increasing

But perhaps the “hunger amidst plenty,” clearly documented by the ten-state US National Nutrition Survey, does warrant a public reaction. To be sure, the malnourished were found more frequently among
the poor, but adequate means do not insure a nutritionally balanced diet. For some unknown reason the public was little concerned when the consequence of an inadequate diet was “only” limited physical development. Now that malnourishment is known to impair mental development, however, a political issue is emerging. Public interest in nutrition has never been keener.

As the choices on the grocery shelf become increasingly more confusing, the consumer must become better educated. For educators this presents both an opportunity and a challenge. The opportunity is in seeking the best way to communicate significant nutrition information. The challenge is to educate the consumer so they can quickly separate fact from fancy. Admittedly, pseudo-nutrition groups peddling their miracle foods are more of an economic burden than a health threat. Most of us instinctively sense the threat to our health if we commit ourselves too thoroughly to a fad that may not have any sound backing in nutritional science. Paradoxically, however, we seem willing to spend millions of dollars in response to promotional schemes that promise health from miracle foods or food supplements. The cure seems to be better consumer education.

In the US, because of highly skilled agricultural producers, only 18 percent of an average income has to be spent to purchase food. This record is unexcelled in today’s world. Thus the opportunity is available for US consumers to balance their diets from readily available and inexpensive foods. With a sharply focused and imaginative educational program, consumers can invest that 18 percent wisely.

Human Nutrition Advances Through Animal Nutrition

In this issue of UTAH SCIENCE we give attention to both animal and human nutrition. In many respects the science of animal nutrition is the more advanced of the two. As a direct result of the ability to experiment and thereby identify the most economic alternative for animal production, animal nutrition has become a science. In observing the response of animals to dietary alternatives, however, much has been learned that has application to human nutrition. It is appropriate therefore that in this special issue of UTAH SCIENCE problems of both animal and human nutrition are treated side by side, particularly since the ultimate goal of animal nutrition is to provide wholesome and nourishing foods to help balance the diet for humans.

The specific areas of emphasis highlighted in the magazine are problems of substance for Utah. Our senior citizens are often at greatest risk and in need of nutritional help. By 1980, about twenty five million people in the US will be over 65. We acknowledge this situation by featuring some of their concerns in “Growing Old in Utah – The Nutrition Side.”

Illnesses can sometimes be effectively treated by means other than medicines; not that medicines are in and of themselves bad. In many cases chemical therapy is the only way to stabilize a malfunctioning human physiology. But whenever the alternative is a drug or diet, my recommendation is to go as far as possible with diet in containing Whenever the alternative is a drug or diet, go as far as possible with diet.
or even curing a disease; therefore, the article, "Foods Instead of Drugs to Offset Diuretic Potassium Losses."

The nutrient composition of both foods for consumers and feeds for animals needs to keep pace with data about nutrient requirements. Application of the knowledge of one component in the equation requires more information about the others. The efficient management of livestock has been aided by application of computer techniques. The difference between economic success and failure for the livestock producer can be a very narrow margin. The staff at Utah State University and the USDA-ARS Collaborators at USU have contributed substantially and originally in this field.

USU Becomes A Nutritional Center

Finally, nutrition and food science at Utah State has come of age with two significant events. With the dedication of the Nutrition and Food Sciences Building at Utah State, a goal was achieved that represented combined efforts of consumers, industry, state government, and the university. At the dedication of that building one of the outstanding nutritionists of the world presented an address which is fundamentally sound and far reaching in substance. And then Utah State University gained even further recognition as a center of nutritional competence and capability, when the International Feedstuffs Symposium was held in July under the direction of Lorin E. Harris. About 350 scientists from all over the world gathered at USU to discuss the finer points of animal nutrition and ways to computerize feed information to assure easy and ready access for all. Both events are signaled in this issue of UTAH SCIENCE.

As food has become relatively scarce and an important component of the international balance of trade instead of an unmanageable surplus in the US, management of national production assumes international significance. More and more people of the world have an interest in US agriculture. For most of the world population the question is how to obtain enough of any kind of food to survive. For the more fortunate it is now possible to ask the qualitative question, are they eating the right kind of food nutritionally. Both are important questions. And solutions to both are being sought by scientists at Utah State University.

R. Gaurth Hansen is Provost and Professor, Department of Chemistry and Biochemistry and Professor, Department of Nutrition and Food Services, USU.
The science of nutrition often is dated from the discovery of oxygen and of oxidation in 1775-1776. During the first century of our country and of nutritional science, ideas flowed rapidly between Europe and America. Following the French Revolution, Napoleon's extensive military campaigns demanded an improved food supply for his army. A monetary prize was offered for the design of a useful method for preserving foodstuffs, and, in 1810, M. Appert was awarded 12,000 francs by the Minister of the Interior, Count of the Empire, upon the recommendation of the Board of Arts and Manufacturers, which included the famous scientist Gay-Lussac. The prize-winning method of food preservation consisted of hermetical sealing of food in glass. Appert's treatise was translated and published in English in 1811.

Within a decade, William Underwood in Boston established a firm for the preservation of food by Appert's process and, in 1839, both Underwood and Thomas Kensett gave up the use of glass bottles and introduced tin-plate containers...the revolution of canning had begun.

This innovation began the continuing series of technological advances in food in America—Gail Borden's invention of condensed milk and its success in supplying military needs during the Civil War; the refrigerated rail transport of meat by Swift; the quick-freezing of food by Clarence Birdseye and development of the necessary refrigerated distribution system for its commercialization; freeze drying foods during World War II—to identify but a few examples of American Genius.

Science and the Founding Fathers

Thomas Jefferson succeeded Benjamin Franklin as Minister to France in 1785. Jefferson has been termed "The Scientific Scout for America." Indeed, these founding fathers set forth the philosophy, not only political, but scientific, which has determined America's greatness. Jefferson, in a letter from Paris, March 24, 1789, wrote to President Williard of Harvard:

...It is for such institutions as that over which you preside so worthily, Sir, to do justice to our country, its productions, and its genius. It is the work to which the young men, whom you are forming, should lay their hands. We have spent the prime of our lives in procuring them the precious blessing of liberty. Let them spend theirs in showing that it is the great parent of science and virtue; and that a nation will be great in both, always in proportion as it is free.
German Chemical Inference

Justus Von Liebig, a German scientist, oriented American agriculture and food and nutrition knowledge toward chemistry. The first American edition of Liebig's "Organic Chemistry in Its Applications to Agriculture and Physiology" was a reprint from the 1840 English edition. Charles Browne notes that:

The influence of Liebig and his school upon agriculture was so overwhelmingly chemical that, for the next half century after publication of his book, chemistry was assumed to be the whole of science in agriculture. The sole importance of chemistry was so ingrained in the public mind that Liebig's pupil, Charles W. Wetherill, was the first scientist to be appointed in the US Department of Agriculture in 1862. For many years after the establishment of agricultural experiment stations, in the creation of which Liebig's graduates played so important a part, it was tacitly assumed by State authorities that chemists were the only ones qualified to be the directors of these institutions. The chemical inspection of commercial fertilizers, another idea of Liebig, and the chief occupation of early experiment stations, had much to do with this attitude."

W. O. Atwater and USDA

This influence led Wilbur O. Atwater to obtain his doctorate under Professor Samuel W. Johnson of Yale in 1869 with an interest in agricultural chemistry which took him to Leipzig and Berlin and subsequently to Carl Voit's laboratory in Munich. In 1875 he became Director of the newly established first state agricultural experiment station at Wesleyan University in Connecticut. His interests and efforts led to passage in 1887 of the Hatch Act establishing, in the US Department of Agriculture, an Office of Experiment Stations of which Atwater became Chief, as well as Director of the new Storrs Experiment Station.

As Director of the federal office, he conceived his mission to be "To bring the stations throughout the country together, to unify their work, and to put them into communication with the great world of science." He was adamant that the Office of Experiment Stations be kept out of politics and that it be placed upon "the highest and truest scientific level."

Just at the end of our first century, the land grant colleges were established by the first Morrill Act of 1862. As America entered its second century, it was Wilbur O. Atwater who provided the remarkable leadership that enabled the implementation of Thomas Jefferson's appeal to President Williard of Harvard that "young men should be enabled to spend the prime of their lives in showing that this nation is the great parent of science and virtue."

Research in Human Metabolism

The emphasis upon energy requirements of man in the early years of this century stemmed...
Nutrition progresses at Utah State University.
Elaboration of the vitamin hypothesis leads to an eruption of interest in nutrition.

from a close association between great American and German nutritional physiologists, Carl Voit, Max Rubner, Graham Lusk, Francis G. Benedict, W. O. Atwater, and others who contributed to later improvements and simplifications of methodology.

Outside the mainstream of science stemming from the best of well-equipped laboratories, there began to emerge experimental clinical research in human nutrition in the middle of America's first 100 years. A youthful graduate of the University of Pennsylvania, John R. Young, presented in 1803 as his graduation thesis "An Experimental Inquiry, into the Principles of Nutrition, and the Digestive Process." This was followed in 1833 by William Beaumont's "Experiments and Observations on the Gastric Juice and the Physiology of Digestion."

There developed wide awareness of the role of nutrition in the management of disease, and of the association between food and the cure or prevention of certain diseases now termed deficiency diseases—scurvy, pellagra, beriberi and sprue—but the state of scientific knowledge could hardly be termed either satisfactory or complete. The need for nitrogen in the form of protein and the presence of some specific amino acids in the protein had been established by Magendie in 1816.

In this country, it was in large measure the influence of the distinguished physiologist, Graham Lusk of Cornell, that placed the science of nutrition on a broader hard base, particularly as relates to metabolism of proteins and fat as well as the energy requirements in disease states.

Newer Knowledge of Nutrition

Eruption of interest in nutrition, experimental, basic, chemical and clinical, followed upon the elaboration of the vitamin hypothesis that stemmed from the classical studies of Sir Frederick Gowland Hopkins. The astute analysis of Casimir Funk in 1911 consolidated the hypothesis and underscored it with a new term "vitamine."

There was a diffusion of interest in nutrition in a wide number of colleges and universities, land grant institutions, departments of home economics, and in schools of medicine, particularly departments of pediatrics and of internal medicine, as well as biochemistry, physiology and other of the basic sciences. This was the era of "the hunger fighters," those enormously imaginative and productive American scientists who contributed to the discovery, identification, isolation, syntheses and subsequent utilization of vitamin after vitamin in the conquest of deficiency diseases.

State of Knowledge Today

The state of knowledge currently is such that nutritional empiricism of the past is replaceable in application with scientific knowledge of metabolism and nutrition. It was Thomas Jefferson who attributed Benjamin Franklin's pre-eminent position in science to his emphasis on "the usefulness of Dr. Franklin's science."

Today's food scientist is concerned with the usefulness of his science. His field grew to provide the scientific base for empirical technology, to prevent problems of spoilage of foods, to preserve food, to improve flavor and acceptability, and ultimately, nutritional quality. Military needs were
a great stimulus to the development of this field.

The Food Scientist

The food scientist's responsibility has extended to nutritional toxicology—carcinogenesis, mutagenesis and other aspects of chemical safety and wholesomeness—and to control and regulate matters. He must be aware of the many factors involved in decision-making: science, economics, social factors, political factors, aesthetics, emotions.

The Responsibility of the Scientist

All scientists concerned with food and nutrition have a unique responsibility that arises because matters pertaining to environmental pollution, safety of the environment, safety and quality of foods, pesticides or additives are emotional subjects for many vocal members of our society. Statements pertaining to such subjects attract immediate attention. It is particularly important, therefore, that information provided by scientists to the public be accurate, balanced and objective and avoid creating a sense of alarm where there is no reason for disquiet.

To Minimize Future Crises

I submit that the knowledge and the planning ability exist to establish a system for the future which will minimize crises and assure increasing improvement of health and relief of human suffering through nutritional betterment.

Will and Ariel Durant wrote in "Lessons from History":

The heritage that we can now more fully transmit is richer than ever before. It is richer than that of Pericles for it includes all the Greek flowering that followed him; richer than Leonardo's, for it includes him and the Italian Renaissance; richer than Voltaire's for it embraces all the French enlightenment and its ecumenical dissemination. If progress is real despite our whining, it is not because we are born any healthier, better or wiser than infants were in the past, but because we are born to a richer heritage, born on a higher level of that pedestal, which the accumulation of knowledge and art raises as the ground and support of our being. The heritage rises, and man rises in proportion as he receives.

May society insure its own future by providing that support essential for us more fully to transmit our rich heritage so that man may rise in proportion as he receives. Failure to do so will impose as penalty a spectre of future want, of need and starvation of inconceivably disastrous consequences. The rewards of success are freedom from hunger and realization of world development through technologic application of scientific knowledge. Success will be in fact the realization of those goals of science envisioned in the 17th Century by Francis Bacon:

...the real and legitimate goal of the sciences is the endowment of human life with new inventions and riches ... not to make imperfect man perfect, but to make imperfect man more comfortable, happy and healthy...

Such is our goal and responsibility as nutrition and food scientists and educators in fulfilling world needs, present and future. Attainment of these goals requires leadership from and understanding of the total community: scientists, educators, politicians and statesmen, economists, governmental officials and the general public.

William J. Darby is president of the Nutrition Foundation, Inc., New York and Washington, D.C. This article is an excerpt from his paper, "Food and Nutrition Sciences and World Needs," presented at the dedication programs for USU's new Nutrition and Food Sciences Building on April 23, 1976.

Give a hoot! Don't pollute.

Maximizing Forage Use in Beef Production

The world population explosion is putting increasing pressure upon food production resources. Feeding of grains to livestock seems destined to decrease so that more grain production can be diverted to direct use by man. Future beef production will, of necessity, be built around increasingly greater use of forage.

Range forage production has been markedly increased during the past two decades in the Intermountain West through improved management and reseeding. In this range area, also, new breeds of cattle (exotics) have been introduced and are being widely used in many areas, although their production abilities have not been determined under this environment.

One research project at USU is developing and testing systems for beef production that maximize forage use and minimize use of concentrates. The project will have a range phase and feedlot phase. Under the range phase, systems of combining use of natural summer mountain range and the reseeded ranges and the native winter ranges will be tested for beef production. Hereford cows will be compared with exotic and Hereford crossbred cows under these systems. Reproductive rates in cows, growth rate in calves and amount of beef produced per unit area will be determined.

Under the feedlot phase, the steers produced in the project will be finished under different levels of concentrates to forage.

Growth rate and feed efficiency as well as carcass quality data will be obtained. In addition, shelf-life of retail cuts, consumer acceptance, cooking losses, flavor, tenderness, and juiciness will be measured.

(Researchers: Bennett, Kearl, Harris)

Phosphorus for Beef Cattle

Experiments at USU with weanling Hereford calves to three years of age show no significant differences in reproduction to date as a result of phosphorus treatments. Neither has there been a difference in body weight or feed efficiency, although there were minimal differences in
blood constituents and in bone and muscle biopsy.

Hay containing the lowest levels of phosphorus available in Utah was selected as the basal feed. Treatments used approximately 60 percent of the commonly recommended levels (basal feed) in one-half of the individually fed diets and approximately 150 percent in the other half.

There were two replications in time, with 48 calves being carried on individual feeding for nine months with measurement of carry over currently approaching three years on individual feeding.

An undergraduate research project indicated that depraved appetite (pica) was not related to the phosphorus treatments.

(Researchers: Call, Blake, Butcher)

**Improved Range Nutrition for Improved Calf Crops**

The critical nutritional period during the last stages of a cow's lactation here in the Intermountain area is usually the early spring during the immature stages of vegetation growth; this situation can lead to late calves and low calf crops.

A recent USU study is documenting the increase in kilograms of beef weaned as a result of improved spring pasture, improvements on a summer range, and a more efficient management strategy on a northern Utah ranch.

The level of beef production and the amount and quality of spring and summer forage before any improvements will be compared to the beef production after range improvements have been implemented. Returns from the increased beef production will be compared to the cost of the improvements to determine the net returns to the rancher.

(Researchers: Ralphs, Butcher)

**Selection of Replacement Heifer Calves**

Over 900 replacement heifer calves were weaned at an average weight of 173 kilograms in mid-November and were fed to gain approximately one pound per head per day, with an average weight of 266 kilograms when breeding was initiated in June of the following year.

In order to approach the desired average weight of 272 kilograms at 14 months of age it was necessary to put these calves in a farm-type feedlot and feed them on silage, alfalfa hay, and a limited amount of barley grain.

The calves were predominantly Hereford with some Angus-Hereford crosses. It was found that the minimum weight before breeding at this age was in the 250 to 260 kilograms range, and the optimum maximum appeared to be 330 kilograms with the greatest criticism of the heavier calves being too much fat.

The criteria for establishing these ranges was based on the efficiency of breeding which approximated 85 percent conception for the calves in the 260 to 330 kilograms range. These cattle were rebred and the average weight in November of the second year of production was 400 kilograms.

The data were verified in two subsequent years with approximately 900 calves in each of these years.

Field studies are continuing on inventory control, critical periods of nutrition and management for optimum range cattle production.

(Researchers: Butcher, Stenquist, Call)

**Inventory Control**

Research conducted at USU indicates that there are three major factors involved in a productive beef cattle operation. These include knowing the number of animals in the operation, being sure that each is a productive unit, and then feeding these animals at a level that will insure maximum return. Continuing research shows that inventory control of animals on a farm or ranch is more of a problem than commonly thought.

(Researchers: Stenquist, Butcher)

**Cattle Feeding**

At the request and cooperation of the Ogden Area Beef Feeders, experiments relative to finishing cattle for slaughter markets have been conducted at USU for the past 15 years. Holstein steers appeared in these studies to be as efficient in producing beef as Hereford steers, especially when sold on a grade and yield basis. Little advantage resulted in providing protein...
Holstein and Hereford used in feeding trials.

Researchers are shown recording feed consumption data for cows on the feed utilization efficiency trial. Cows were tied to their designated feed manger four times daily throughout the 305-day lactation. Cows were housed together in open sheds similar to conventional dairy housing units.

Supplements, since Utah’s natural feeds are generally adequate in protein.

Finishing cattle did not respond directly to temperature, precipitation, or barometric changes, although there was a depression in feed efficiency in the cold, wet, sloppy pens of winter.

There was no apparent difference between Hereford steers and Charolais-Hereford crossbred steers in efficiency of meat production, although the crossbred steers did require a heavier weight to meet slaughter grades. One experiment indicated a significant feed saving by putting weaning calves into the feedlot, growing them out, and finishing them as soon as practical as compared to cattle of the same age and breeding that were “roughed” through the winter, summered on pasture, and finished at a significantly older age.

Rumensin appeared as effective as generally reported in the literature for increasing feed efficiency, although the levels of Rumensin fed must be adjusted to the weight of animal used. Cubed alfalfa appeared more efficient for growing diets for heifer or steer calves than chopped alfalfa. This was apparently a result of increased feed consumption when cubes were fed.

(Researchers: Stenquist, Butcher)

Dairy Cattle

A consistent concern at USU has been with genetics and the breeding of dairy bulls and cows.
that would assure economical production levels.

In the recent past, dairymen wanted animals that would give high milk production while on high grain rations. Now that feed grain prices are soaring, the need is for animals that can produce efficiently on low-grain or all-forage diets. One substantial research effort at USU has been trying to answer questions raised by this shift.

**Feed Utilization Efficiency**

To determine whether breeding and selection programs must be changed along with changed feeding patterns, workers at USU began a two-phase research project on the subject.

In the first phase, the feeding of four different rations to 289 daughters of 18 Holstein sires showed that a standard, hay-plus-grain ration resulted in better milk production efficiency than all forage. Gross feed utilization efficiency was highly correlated with level of milk production, indicating that selection for high milk yield is also selection for efficient feed conversion. The general conclusion drawn from this work was that current selection procedures will not be detrimental to feed utilization efficiency, even under drastically different feeding programs.

Data from the second phase have not yet been analyzed, but are expected to define the influence and interaction of nutritional level and genetic background on feed utilization efficiency, production, and reproduction of first-lactation cows. Three hundred animals have been involved in this second phase.

(Researchers: Lamb, Anderson, Stoddard)

**Prelactation Exercise**

One major problem associated with managing modern dairy cows is their low consumption of feed immediately following parturition. During this period, while daily milk production is increasing rapidly, appetites are depressed relative to nutrient needs and physiological systems are not functioning optimally. As a result (particularly in high-producing cows) body reserves are depleted and then milk production begins to decline. Achieving a viable energy balance
for the animal early in lactation is especially difficult under group management systems. But such difficulties might be avoided by subjecting cows to measured exercise and a modified diet for 60 days before they are due to calve, and USU workers are now investigating this possibility.

So far, the researchers have imposed an exercise pattern on 100 cows and heifers. Based on a subsequent fitness test, the physical condition of many of the animals was definitely improved by the exercise. Other results included easier calving, a shortened time between calving and release of the placenta, and a relatively quick uterine return to normal.

(Researchers: Lamb, Anderson, Mickelsen)

Liquid Whey as Ruminant Feed

A small part of the cheese industry’s liquid whey has been fed to swine and poultry for years—the sole outlet of any size. The rest of this byproduct was dumped. But when cheese plants were ordered to cease dumping whey in the interest of nonpollution, alternative markets became a necessity. One market was dried whey for bakeries, candy makers, and other commercial food processors but drying equipment is expensive, especially for small plants, and the market is limited.

As one possible solution to the problem, researchers here started feeding liquid whey to dairy animals at the USU Dairy Research Farm. They also checked the digestibility of whey for ruminants. In another trial, they determined the effects of whey on volatile fatty acids in the rumen.

After acceptance of the whey by the milking cows, 16 of them were fed liquified whey during their dry periods and until 30 to 60 days postpartum, at which time they were grouped by fours and assigned to four levels of whey. The experiment lasted for 16 weeks. Alfalfa hay was offered ad libitum and grain was fed at the rate of 7.5 kg per cow daily.

In this study, hay intake dropped off among the dairy cows, indicating that whey could replace part of the feed concentrates.

In a different study, 18 Holstein heifers, 6 to 8 months of age, were assigned at random within each group to one of three whey-feeding treatments. This 16-week study indicated that the liquid whey was equal in feeding value to 2.3 kg of grain.

In the course of the feeding experiments, it was discovered that adult dairy cows would not readily consume sour whey. In tests with 18 Holstein calves weighing approximately 120 kg, both formaldehyde-treated and sour whey were readily consumed. A high-quality alfalfa hay was used initially in the study and several cases of bloat occurred. When a poorer quality hay was used, bloating ceased. No other adverse effects were noted from formaldehyde treatment in these short-term trials.

(Researchers: Anderson, Lamb)
Computerized Rations for Increasing Profits from Dairy Cows

M. J. Anderson

The use of computers for calculating rations for dairy cattle is increasing in popularity. Most computerized programs in the United States are of the least-cost type and suggest feeds that satisfy the animals' nutrient requirements at the least expense. Profitable levels of production must be maintained for these rations to work successfully. Utah State University has recently started to provide a computerized ration service for dairymen. This service can significantly enhance feeding efficiency.

But since the computer cannot think, careful preplanning by the dairyman and the computer operator is required if the results are to be validly useful. Because unrealistic rations are sometimes created, the dairyman should examine computer-formulated rations carefully before accepting them. If there is any question, the Extension Dairyman should be contacted immediately.

What the Computer Can Accomplish

When given the proper data, the computer will calculate the requirements of dairy cows for net energy for milk or TDN, protein, calcium, phosphorus and crude fiber, according to the size of cow, level of production, butterfat test and age. The computer considers the cost of the available feeds and calculates the lowest cost ration that satisfies the requirements of the animals using the choices of feeds available.

Feeds that satisfy the requirements for protein, calcium, fiber and net energy for milk nearly always provide an adequate ration for dairy cows. However, trace mineralized salt should be provided free choice, and if carotene has been destroyed in the feeds, a vitamin A supplement is necessary.

Limitations of the Computer

The computer cannot determine acceptability or palatability of feeds. High-quality feeds, especially forages, are usually consumed at higher levels than poor quality feeds. If quality of feed is expected to affect intake, the computer program should be adjusted.

Most computer programs do
not consider minerals other than calcium, phosphorus, and salt. Since at least 15 mineral elements are essential to dairy cows, the majority do not enter into the calculations. The same is true for vitamins A, D, and E. These minerals and vitamins can easily be added to the ration if deficiencies are considered likely.

Sometimes certain combinations of feeds in a ration stimulate production that is not explainable by the nutrients the feeds contain. These associative effects and other factors that might stimulate production or health of the animal are not included in the computer program. Similarly, the effects of poor management in feeding and in other phases of the dairy operation are also ignored. A poor feeding program will result in poor production, but a good feeding program will not result in high production if other management phases are deficient.

Information Supplied by the Dairyman

The success of a computer program is dependent upon the quality of the information provided. This information should be as accurate as possible.

Since nutrient requirements are calculated by the computer on the basis of body size, level of production, butterfat test and age of the animal, this information must be supplied. Usually average values for a string or herd are used. Cows cannot sustain production levels higher than their feeding levels. To avoid underfeeding (especially the high producers) a feeding level slightly higher than is satisfactory for the current average production level may be advisable. Calculating individual cow rations is not feasible, but if individual feeding of grain is desired, adjustments based on the average rations can be made.

Each dairyman must provide a list of feeds available and their costs. The list should include the feed quality and/or analysis data, if possible. This is because the same feeds are not available in all localities, prices change, and some dairies are not equipped to utilize certain feeds. Prices quoted should include processing and delivery costs for purchased feeds. Equally realistic values should be assigned to home grown feeds. However, if these values are too high, other feeds will be recommended in their place.

Because quality of forages makes a big difference in their nutritive value, feed analyses, although not indispensable for computerized rations, can materially help assure an optimum ration.

The dairyman should decide if he wants restrictions inserted in the computer program relative to certain feeds. The three types of restrictions that are used can be in terms of pounds or a percent of the total ration. They are: 1) Include a definite amount of a certain feed regardless of cost. An example would be the feeding of 10 pounds of one type of hay. 2) Use up to but no more than a given level of a feed. Certain feeds such as corn silage, molasses, bloat-causing hay, and urea may not be fed in excess of established levels, even when they are considerably lower in price. 3) Use a specified minimum amount of a certain feed regardless of prices. Higher levels will be used when prices are favorable. For example, a mini-
mum amount of dry hay is usually recommended. Beet pulp or other bulky feeds may be desired, but high prices may exclude them unless the computer is told to include them at some minimum level.

What the Computer Provides

The USU computerized ration is printed in terms of pounds of feed per cow per day. The dairyman must then compute the actual amount the herd or string receives daily and the composition of the grain mixture.

In addition to the actual ration, the computer lists information about the composition of all feeds considered, feasible cost of those feeds rejected, the value of milk, cost to feed each cow per day, and expected income over feed costs. Some information about feeds and the ration is presented on both an as-is and a 100 percent dry matter basis.

Precautions

Cows may be adversely affected by ration changes, therefore, they should be gradually changed to new rations, especially when the change is drastic. A 10-day to 2-week adjustment period may help prevent serious drops in production.

Rations should be checked carefully to insure that correct restrictions have been imposed. Unrealistic rations will result if improper restrictions are used. Errors in key punching the information can lead to undesirable results. Results are checked but dairymen still should be alert to the possibility of errors or unrealistic rations.

Frequency of Computing Rations

New rations should be formulated whenever major changes occur in availability or prices of feeds. Otherwise, recalculation two or three times per year is adequate.

Cost of Calculating Rations

The basic cost for the USU program is $5. This provides the dairyman with three different rations. The three rations can be designed for use with different strings or different levels of production, or to allow for different ingredients or restrictions. An additional charge of $1 is made for each ration beyond the basic three.

The County Extension Agent can provide dairymen with forms that specify the necessary information. Advice can also be given about restrictions and can help with interpretation of the rations.

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Feed Analyses -

Key to Effective Rations

M. J. Anderson

Increases in feed prices have made livestock producers aware of the need to stretch their feed dollars as far as possible. One method is to test feeds for their nutrient contents and then properly interpret and use the results of the analysis. Feed composition tables (Table 1) are useful indicators but may not be accurate for a specific lot of feed. When feed samples are not taken correctly, the effects of stage of maturity, weather, and harvesting conditions can not be evaluated in nutrient terms. If the sample is not representative, however, the results will have no value. Descriptions of proper sampling procedures are available from the feed testing laboratory or from the Extension Service. Random samples should be taken from several sites within a particular lot of feed. That is because two adjacent bales frequently differ in composition and relative value more than do two separate lots of hay. Samples of alfalfa hay should contain the same proportion of leaves and stems as in the total lot of hay because leaves are about twice as high in energy value and protein as the stems.

Major Tests

Only tests that will influence the feeding program should be conducted. Other tests simply waste time and money. For example, grains vary less in composition than do forages. With good quality grains, i.e. good full kernels, nutrient values usually can be closely estimated from feed composition tables and little additional information will be gained from running feed analyses. Some varieties of grain, however, differ from normal in protein content and for these it might be advisable to analyze the protein content. Also, if a grain is not thoroughly dry, its moisture content should be determined.

The most valuable determination made on silages, haylage and other high moisture feeds is of their moisture content. Measures of energy and protein contents of hay crop silages and haylage are useful in calculating rations but are difficult to derive unless the moisture is known. A certain amount of moisture is necessary in feeds for palatability and for proper preservation of some feeds, but feeds should primarily supply nutrients and not satisfy water requirements.

Lack of sufficient useful energy is the most common nutritional deficiency in high producing dairy cows. Hays and hay-crop silages vary widely in

Nitrates in feeds can result in nitrate poisoning.
Table 1. Typical composition of some common feeds. Values are on a dry matter basis.

<table>
<thead>
<tr>
<th>Feed Type</th>
<th>NEL**</th>
<th>TDN**</th>
<th>CP**</th>
<th>DP**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kcal/lb % % % %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prebud — &gt;20% Protein</td>
<td>680</td>
<td>66</td>
<td>&gt;20</td>
<td>&gt;14.5</td>
</tr>
<tr>
<td>Bud 18-20% Protein</td>
<td>635</td>
<td>63</td>
<td>18-20</td>
<td>14.5</td>
</tr>
<tr>
<td>Early bloom 16-18% Protein</td>
<td>594</td>
<td>60</td>
<td>16-18</td>
<td>12.5</td>
</tr>
<tr>
<td>Mid bloom &lt;16% Protein</td>
<td>548</td>
<td>57</td>
<td>&lt;16</td>
<td>&lt;12.5</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>630</td>
<td>63</td>
<td>9</td>
<td>4.5</td>
</tr>
<tr>
<td>Corn 60 lbs/bu</td>
<td>1098</td>
<td>91</td>
<td>9</td>
<td>4.5</td>
</tr>
<tr>
<td>Barley 48 lbs/bu</td>
<td>970</td>
<td>83</td>
<td>12</td>
<td>8.0</td>
</tr>
<tr>
<td>Wheat</td>
<td>1050</td>
<td>88</td>
<td>13</td>
<td>9.0</td>
</tr>
<tr>
<td>Beet pulp — Molasses dried</td>
<td>803</td>
<td>72</td>
<td>8</td>
<td>4.0</td>
</tr>
</tbody>
</table>

*Hay harvested under good conditions, no excessive leaf loss.
**NEL=Net energy for lactation (or milk); TDN=total digestible nutrients; CP=Crude Protein; DP=Digestible Protein.

energy value, thus a specific analysis is needed of such feeds.

After energy, the second most valuable bit of information about a forage is its protein content. While adequate protein supplements must be provided when needed, they are a waste of money if not needed. Generally, as the protein content increases the energy value also increases, especially for alfalfa. Thus protein content is sometimes used to estimate energy value, although this estimation has some limitations.

Other Tests

Other tests are recommended only for special conditions. Heated forages have lower energy and digestible protein contents. Tests are available that can measure heat damage effects. Silages and hays that are brown or black because of heat should be analyzed to determine the extent of damage. Nitrates in feeds can result in nitrate poisoning. If high levels are suspected (as may occur in grasses such as sudan grass that have been heavily fertilized with nitrogen or poultry manure), an analysis is in order. High-nitrate feeds adequately diluted with low-nitrate feeds can provide a safe ration.

Phosphorus content of forages can vary considerably as a result of soil conditions. If phosphorus supplements are scarce and expensive, and if forage constitutes a major part of the ration, a phosphorus analysis may be desired. Alfalfa hay is high in calcium and 10 pounds of alfalfa will nearly always satisfy the calcium requirements of the dairy cow. If limited alfalfa is fed, a calcium analysis of the feeds used may be warranted. Also, when milk fever becomes a problem the calcium: phosphorus ration may need to be modified, which could require analysis for these elements.

Analyses for other nutrients or compounds should be conducted only under very special conditions. Examples could include trace minerals, poisons or toxic substances and agricultural chemicals which could be transferred to milk or meat. However, these tests are usually conducted by regulatory agencies.

Interpreting Results of Analysis

The better the forage quality, the less concentrate will be required for an animal to achieve a given level of production. Since concentrates and protein supplements are usually more expensive than forages, it is advisable to calculate (or balance) a ration toward satisfying requirements for the expected level of production. Results of feed analyses are used for these computations, regardless of whether the ration is balanced using the computer or manually. As quality of feed increases, level of production should increase. If this happens, a new ration may have to be computed to account for the higher level of production.

Rations can be more accurately balanced (necessary nutrients provided) if the results of feed analysis are available. Computerized programs use the
Generally, as the protein content increases the energy value also increases.

results of feed analysis to insure that requirements of the animals are satisfied and at the same time consider the cost of ingredients. The end result is high production at the most economical cost.

Summary of Available Tests

Tests having high value:

Net energy lactation or TDN. Especially important for hay and hay crop silage, fairly important for corn silage. For grains, values from tables of feed composition are often as valuable as analysis when kernels are full and quality is good.

Moisture (or dry matter). A must for silages and other high moisture feeds. Not critical for dry feeds such as hay and grain which usually contain 87 to 91 percent dry matter.

Protein. Valuable for hay and hay crop silage. Less important for corn silage and cereal grains.

Tests having limited value:

Heat damage. This is especially valuable for silage or haylage. Heat damage lowers protein digestibility and particularly lowers the energy content.

Ash. Ash content may give an indication of contamination with dirt, which may affect palatability and reduce nutrient value.

Phosphorus. Generally values from feed composition tables are recommended although an analysis would aid in a more accurate assessment of the phosphorus intake.

Calcium. In most instances where 10 pounds or more of alfalfa is fed per cow daily, the calcium requirements will be satisfied. However, if milk fever becomes a real problem and if the calcium:phosphorus ratio becomes extremely critical, calcium analysis may be warranted.

Carotene (Vitamin A). From analysis it could be determined whether adequate carotene is present to satisfy the requirement. However, the cost of analysis could exceed the cost of recommended supplantations.

Nitrates. Some grasses, especially sudan grass, accumulate nitrates which can cause nitrate poisoning. This occurs primarily on soils which have received heavy applications of nitrogen fertilizers or poultry manure. Animals can tolerate some nitrates, thus high nitrate feeds can be diluted with other feeds and still safely be used. When high nitrates are suspected, a nitrate analysis should be made.

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National Hunting & Fishing Day

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Potassium is one of the so-called electrolytes that are crucial to human health. Unfortunately, a wide variety of drugs and diseases can cause diverse electrolyte imbalances. In recent years, potassium loss has become a particularly common medical problem because of the increased use of diuretics.

Diuretics, which enhance the urinary excretion of sodium and water, are used to reduce the volume of extracellular fluid and to prevent or combat edema (excess retention of body water). They achieve that goal by accelerating urine formation or, more commonly, by depressing renal (kidney) reabsorption of water and sodium. Diuretics are often prescribed for patients with hypertension (high blood pressure), congestive heart failure, or hepatic (liver) abnormalities. Since each diuretic has its own mode of action and potential side effects, even a careful matching with the patient’s particular situation cannot preclude the chance of problems.

The commonly used thiazide (diurel and hydroxydiurel) diuretics are called “potassium wasting.” Other diuretics have little effect on potassium, while some actually conserve potassium at the expense of sodium. The more potent diuretics, however, tend to produce significant potassium losses.

Physicians currently deal with potassium deficiencies by combining potassium-sparing diuretics with supplemental potassium salts. Unfortunately, both of these classes of drugs incorporate certain disadvantages. For example, the potassium-sparing diuretics can produce elevated blood urea nitrogen, dizziness, vomiting, diarrhea, flaccid weakness, etc. Potassium salts (especially the popular potassium chloride) can have side effects that generally include irritation of the upper small intestines. In addition, the supplements are not always well absorbed and can generate a false sense of security in patients who rely on them.

Potassium from Foods

As an alternative to the drug therapy side-effects merry-go-round, we propose a qualitative diet therapy. In other words, a proper choice of foods can effectively offset potassium depletion problems.

In general, of course, the diets of some individuals may not provide adequate potassium even before they encounter illnesses or drug therapy regimes. For example, some fully ambulatory geriatric patients have been found to have a potassium intake of only 50 milliequivalents (1950 mg) per day, when their estimated need was for 100 milliequivalents. But whether induced by low appetites, poor food choices, disease, or drugs, potassium deficiency can be more pleasantly cured by foods that provide adequate absorbable potassium than by drug supplements with their unpleasant side effects.

Patients are occasionally given...
food lists or counseled by physicians to consume foods high in potassium, but they are rarely given comprehensive instructions on the quantities that should be eaten. Many times, foods high in potassium are simply added to the patient’s normal diet without being considered in terms of their caloric and other nutrient contributions.

Some Specifics

Admittedly, it has been difficult to determine the exact amount of potassium likely to be derived from food sources, but an effective, quantitative method for integrating high-potassium foods into the total diet is now available. The Index of Nutritional Quality (INQ) developed at Utah State University measures a food’s nutrient to calorie density:

\[
\text{INQ} = \frac{\text{Percent of nutrient requirement in a quantity of food}}{\text{Percent of energy requirement in a quantity of food}}
\]

A computer program has been developed which can calculate the INQ for each nutrient of concern. The result is then summarized as a graphic profile of nutrient content. The ratio of the food’s nutrient content to its energy content remains constant. The quantity of food in question is thus immaterial to calculations of the INQ. The USU research group evaluated numerous foods to determine whether each has a high density of potassium relative to its kilocalorie and sodium contents. Sodium was included because patients on diuretic therapy are often on sodium-restricted intakes as well.

For illustrative purposes, the common prescription of 132
milliequivalents (5150 mg) of potassium and 87 milliequivalents (2000 mg) of sodium per day for patients on diuretic therapy has been used as a standard. The daily intake of potassium for most people averages 100 milliequivalents (3900 mg) per day, with a range of 40-153 milliequivalents (1560-5970 mg). The average potassium chloride supplementation level supplies 32 milliequivalents (1250 mg), which is believed to adequately offset the potassium lost during therapy. The sodium standard of 87 milliequivalents (2000 mg) represents the no-salt-added dietary prescription, which is given to many hypertensive patients.

An INQ above "1" for potassium in a food indicates that the amount of the food that would satisfy an individual's total energy requirement for a day (2300 kcal) should also supply the required amounts of potassium. Conversely, a food with an INQ lower than "1" would be a poor choice for the patient needing potassium repletion because it would not supply enough potassium relative to caloric contribution. To be appropriate for a patient on potassium-wasting diuretic therapy and a moderately sodium-restricted diet, a food would need to have an INQ above "1" for potassium and below "1" for sodium. The illustrations reflect standards that are appropriate for many patients. The computer program, however, can be easily modified to fit any sodium and potassium dietary requirements.

In the unlikely situation of fresh halibut being used as the

![Image of food analysis charts]

Figure 4. Raisins, a food traditionally used for potassium supplementation, only has a potassium INQ of 1.13.

![Image of food analysis charts]

Figure 5. Sauerkraut is high in potassium (INQ = 3.34) and sodium (INQ = 47.72).

![Image of food analysis charts]

Figure 6. The profile for a banana illustrates a range of nutrients for which INQs can be calculated.
sole source of a person's energy, a 2300 kilocalorie portion would supply 62 percent of the 87 milliequivalents (2000 mg) of sodium and 193 percent of the 132 milliequivalent (5150 mg) standard for potassium (Figure 1a). Most people, however, consume a variety of foods each day. Figure 1b shows the ratio of nutrients to energy (INQ), in a 3.5 ounce serving of halibut. Such a serving of halibut provides 100 kcal, which is 4 percent of our assumed 2300 kcal energy requirement per day for an average adult, and 8 percent of the daily potassium prescription. The same serving would also provide 3 percent of the sodium prescription.

A large baking potato has exceptionally high potassium, and low sodium contents (Figure 2). The potato would provide only 8 percent of a person's total energy requirement and less than one percent of the sodium prescription, but would contribute 19 percent of the dietary potassium prescription (INQ = 2.32).

Each one percent of the energy requirement satisfied by cooked asparagus (Figure 3) would provide 3.9 percent of the potassium requirement. Since the caloric content is so low, almost unlimited quantities can be consumed. One serving of asparagus provides 5 milliequivalents (195 mg) of potassium and only 20 kcal. A 5/8 cup serving of raisins, a more traditionally favored food supplement for dietary potassium, provides 20 milliequivalents (780 mg) of potassium but also contains 289 kcal (Figure 4). The raisins' potassium INQ is therefore only 1.13, or about one-third that of asparagus. Thus, on a per calorie basis, asparagus contains approximately three times more potassium than raisins.

Sauerkraut, as seen in Figure 5, has an excellent INQ for potassium (3.34), but would not be included on lists for potassium supplementation because of its inordinately high sodium content (INQ = 47.7).

The USU research group has incorporated nutrient composition of over 2000 foods into their computer program (Table 1). To illustrate how this data bank can be used to evaluate a food for its overall nutrient value, Figure 6 presents a profile of eighteen of the essential nutrients in a medium banana. From this profile it can be seen that bananas are a good source of potassium (INQ = 1.87), and an even better source of ascorbic acid (INQ = 4.51). Bananas also contain adequate amounts of iron (the most difficult nutrient to supply in adequate amounts in American diets), and close to the required amounts of vitamin A, thiamin, riboflavin, and niacin.

In Table 1, individual foods have been grouped into classes that emphasize their potassium contents. Foods listed in regular type contain potassium in amounts relatively less than their caloric contents, i.e., they have potassium/calorie INQs less than "1." These foods would have to be consumed in excess of energy needs to meet the potassium supplementation requirement. In contrast, the foods underlined have high potassium/calorie INQs and should consti-
Table 1. Dietary Potassium Food Supplement List

<table>
<thead>
<tr>
<th>Dairy Products</th>
<th>Meat, Poultry, Fish</th>
<th>Dry Beans, Nuts</th>
<th>Vegetables (fresh)</th>
<th>Fruits</th>
<th>Grain Products</th>
<th>Misc. Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foods High in potassium (8.0 Meq/serve or more)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Milk, +Butter low fat</td>
<td>+Abalone, canned</td>
<td>Almond meal</td>
<td>Avocado, raw</td>
<td>Apricots, dried</td>
<td></td>
<td></td>
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<tr>
<td>+Yogurt from skin milk</td>
<td>Beef, ground</td>
<td>navy beans</td>
<td>Bamboo shoots, raw</td>
<td>Bananas</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>oven roast</td>
<td>red</td>
<td>raw</td>
<td>Breadfruit, raw</td>
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<tr>
<td></td>
<td>pot roast</td>
<td>soy</td>
<td>boiled</td>
<td>Fruit cocktail, canned</td>
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<tr>
<td></td>
<td>pot pie</td>
<td>white</td>
<td>Mushrooms, raw</td>
<td>Grapefruit juice</td>
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<tr>
<td></td>
<td>sirloin steak</td>
<td></td>
<td>cooked</td>
<td>Grapefruit-</td>
<td></td>
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<tr>
<td></td>
<td>vegetable stew</td>
<td></td>
<td>salad</td>
<td>orange</td>
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<td></td>
<td>Bluefish, baked</td>
<td></td>
<td></td>
<td>Melon</td>
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<td></td>
<td>Catfish, Chicken</td>
<td></td>
<td></td>
<td>casaba</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>+chow mein, canned</td>
<td></td>
<td></td>
<td>honeydew</td>
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<tr>
<td></td>
<td>pot pie</td>
<td></td>
<td></td>
<td>musk</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>white &amp; dark</td>
<td></td>
<td></td>
<td>water</td>
<td></td>
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<tr>
<td></td>
<td>+Chili con carne</td>
<td></td>
<td></td>
<td>Nectarine</td>
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<tr>
<td></td>
<td>with beans, canned</td>
<td></td>
<td></td>
<td>Orange, navel</td>
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<tr>
<td></td>
<td>+Cod, canned</td>
<td></td>
<td></td>
<td>Orange juice</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Flounder, baked</td>
<td></td>
<td></td>
<td>Papaya</td>
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<tr>
<td></td>
<td>Haddock, raw</td>
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<td></td>
<td>Pears, canned</td>
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<td></td>
<td>Halibut, baked</td>
<td></td>
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<td>Prunes, uncooked</td>
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<tr>
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<td>Herring, raw</td>
<td></td>
<td></td>
<td>Raisins</td>
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<td></td>
<td>Lambchop</td>
<td></td>
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<td></td>
<td>Lake herring</td>
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<tr>
<td></td>
<td>Mackerel, raw</td>
<td></td>
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<tr>
<td></td>
<td>Perch, raw</td>
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<tr>
<td></td>
<td>Pike, raw</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>+Sardines, canned</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>+Scallops, cooked</td>
<td></td>
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<tr>
<td></td>
<td>Veal, roast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foods moderately high in potassium (2.6-7.9 Meq/serve)</td>
<td>+Cottage cheese ice cream</td>
<td>+Beans with pork &amp; tomato sauce</td>
<td>+Artichoke, boiled nectar</td>
<td>Apricots, raw canned nectar</td>
<td>Cereals: oatmeal, cooked</td>
<td>+Beef broth</td>
</tr>
<tr>
<td></td>
<td>+Bass, fresh</td>
<td></td>
<td></td>
<td>Blackberries</td>
<td>+Macaroni &amp; cheese</td>
<td>+Chicken broth</td>
</tr>
<tr>
<td></td>
<td>+Beef, chiped dried</td>
<td></td>
<td></td>
<td>+Asparagus boiled</td>
<td>+Rice, cooked</td>
<td>+Soup</td>
</tr>
<tr>
<td></td>
<td>Clams, raw</td>
<td></td>
<td></td>
<td>Scoops, boiled</td>
<td>+Vegetable beef</td>
<td>+Mirenostrone</td>
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<td></td>
<td>Lamb leg, roasted</td>
<td></td>
<td></td>
<td>+Beets, canned</td>
<td>+Beef</td>
<td>+vegetable</td>
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<tr>
<td></td>
<td>Liver</td>
<td></td>
<td></td>
<td>Broccoli, cooked</td>
<td>+beef</td>
<td>+beef</td>
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<tr>
<td></td>
<td>Porkchop</td>
<td></td>
<td></td>
<td>Brussels sprouts</td>
<td>+beef</td>
<td>+beef</td>
</tr>
<tr>
<td></td>
<td>+Tuna, canned</td>
<td></td>
<td></td>
<td>Cabbage, raw cooked</td>
<td>+beef</td>
<td>+beef</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+Carrots, cooked</td>
<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Cauliflower cooked</td>
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<td>+beef</td>
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<td></td>
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<td>Corn, sweet cooked</td>
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<td>Eggplant, cooked</td>
<td>+beef</td>
<td>+beef</td>
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<td></td>
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<td></td>
<td></td>
<td>Lettuce</td>
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<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Onion</td>
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<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Peas, fresh</td>
<td>+beef</td>
<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Peas, cooked</td>
<td>+beef</td>
<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Pickle, dill</td>
<td>+beef</td>
<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Potato, boiled mashed</td>
<td>+beef</td>
<td>+beef</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+Sauerkraut</td>
<td>+beef</td>
<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>+Spinach</td>
<td>+beef</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Summer squash</td>
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<td>Succotash, cooked</td>
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<td></td>
<td></td>
<td></td>
<td>Tomato, raw</td>
<td>+beef</td>
<td>+beef</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+Celery, raw</td>
<td>+beef</td>
<td>+beef</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cucumber, raw</td>
<td>+beef</td>
<td>+beef</td>
</tr>
<tr>
<td>Foods low in potassium (2.5 Meq/serve or less)</td>
<td>+Cheese, cheddar</td>
<td>+Anchovy, pickled</td>
<td>+Celery, raw</td>
<td>Bread, white</td>
<td>+Bread, white</td>
<td>+Butter</td>
</tr>
<tr>
<td></td>
<td>+Swiss</td>
<td>+Bacon</td>
<td></td>
<td>whole wheat</td>
<td>+Catsup</td>
<td>+Catsup</td>
</tr>
<tr>
<td></td>
<td>Eggs, boiled</td>
<td>+Bologna, 3&quot;</td>
<td></td>
<td>Chocolate chip</td>
<td>+Cocoa, dry powder</td>
<td>+Cocoa, dry</td>
</tr>
<tr>
<td></td>
<td>Sherbet</td>
<td>+Sausage, links</td>
<td></td>
<td>cookie</td>
<td>+French dressing</td>
<td>+French dressing</td>
</tr>
<tr>
<td></td>
<td>Sherbet</td>
<td></td>
<td></td>
<td>+Cupcake</td>
<td>+Mayonnaise</td>
<td>+Mayonnaise</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fig Bar</td>
<td>+Mustard</td>
<td>+Mustard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+Tomato, raw</td>
<td></td>
<td>Cheese, dried</td>
<td>+Salad oil</td>
<td>+Salad oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+juice</td>
<td></td>
<td>corn meal</td>
<td>+Sugar, white</td>
<td>+Sugar, white</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vegetable, mixed</td>
<td></td>
<td>corn flakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>farina</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>puffed rice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Underlined foods are good sources of potassium in terms of caloric content, i.e., INQ's greater than "1". +High sodium foods, i.e., INQ > 1:00. 

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tute most of the potassium-seeking individual’s diet.

Foods high in sodium content have been marked with a “+,” i.e. INQ greater than one. People on sodium-restricted diets should beware of these foods except on rare occasions and in small amounts.

Obviously, foods can provide a practicable alternative to drugs as a source of potassium. The computerized USU food data bank is also finding increasing use by physicians, dietitians and nutritionists as a basis for counseling individuals with diverse dietary problems. In essence, by devising and computerizing the INQ concept, the USU researchers have facilitated sensible food choices by anyone interested in optimizing their nutritional status.

Growing Old In Utah - The Nutrition Side

Deloy G. Hendricks, Sharon Fisher, Flora Bardwell and Arthur W. Mahoney

When we are lonely, or on a tight budget, or feeling unwell, or experiencing a combination of such stresses, we tend to neglect nutrition—which is undesirable at any age, but can be downright dangerous for senior citizens.

To find out whether achieving adequate nutrition is a problem for Utah’s elderly and to answer other related questions, an evaluation phase funded by Utah State University’s Quality of Rural Life Program was attached to a Vista-funded Seniors Nutrition Aide Program (SNAP) in the five-county area of southwestern Utah.

The Vista program was designed to help communities capitalize upon the experience resources represented by their elderly citizens. The program encouraged cooperative interaction among the elderly and youth groups. By promoting involvement in gardening and in the sharing of food products, Vista personnel expected that senior citizens would have their food supplies supplemented and the youngsters would learn from the time-proved insights of some of the seniors. The results have been most rewarding. Gardens have been planted where space for gardens had been abandoned. Drawing on the expertise, advice and direction of the senior citizens and combining that with the time, energy and willingness of the youth resulted in gardens in twenty communities. Usually these activities were supervised by a volunteer 4-H club leader. Vegetables were distributed to elderly in the communities as they were harvested.
Many established gardens produced food to share with senior citizens of the communities. In this case, awareness of the needs of the target population was increased by involving producers and youth in distributing garden products.

Members of the Nutrition and Food Sciences Department at Utah State University evaluated the nutritional status of some of the elderly participants in this program. Both dietary and biochemical evaluations were made. In addition, a general information questionnaire provided data about general living situations and health conditions.

On the average, those surveyed were well nourished and were very concerned about maintaining optimum health. About 5 to 10 percent, however, were deficient in one or more nutrients, some to a point of severe concern such as iron deficiency anemia. Overweight, high blood pressure and high serum cholesterol levels were common among the individuals interviewed.

Socio-economic Characteristics

Of the 300 people (66 percent women) involved in the nutrition survey, 45 percent had not completed high school. One-third of the population lived alone. Ten percent had an annual income of less than $2000. Ninety percent of those with very low income levels were over 65 years of age. The mean age of the 300 was 68 years, with a range of 41 to 93 years. All of the participants were Caucasian, with 90 percent being homeowners.

Sixty percent of those sampled had gardens and 79 percent preserved some food items. However, as income decreased so did the percent having gardens.

Table 1. Mean dietary intake of Utah rural elderly

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Male Mean Intake</th>
<th>Recommended</th>
<th>Female Mean Intake</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY (Kcal)</td>
<td>1945</td>
<td>2400</td>
<td>1470</td>
<td>1700</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>80</td>
<td>65</td>
<td>64</td>
<td>55</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>875</td>
<td>800</td>
<td>690</td>
<td>800</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>12.4</td>
<td>10</td>
<td>9.9</td>
<td>10</td>
</tr>
<tr>
<td>Vitamin A (I.U.)</td>
<td>9555</td>
<td>5000</td>
<td>7117</td>
<td>5000</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>98</td>
<td>60</td>
<td>93</td>
<td>55</td>
</tr>
<tr>
<td>Thiamin (mg)</td>
<td>1.2</td>
<td>1.2</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Riboflavin (mg)</td>
<td>2.0</td>
<td>1.7</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Cholesterol (mg)</td>
<td>459</td>
<td>&lt;500</td>
<td>343</td>
<td>&lt;500</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>5.1</td>
<td>&gt;3</td>
<td>4.2</td>
<td>&gt;3</td>
</tr>
</tbody>
</table>

Table 2. Biochemical findings in Utah’s rural elderly

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Male Mean</th>
<th>Female Mean</th>
<th>Acceptable Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin, gms/100 ml</td>
<td>16.2</td>
<td>15.0</td>
<td>&gt;14.0/12.0*</td>
</tr>
<tr>
<td>Hematocrit, %</td>
<td>47.2</td>
<td>44.0</td>
<td>&gt;44/41</td>
</tr>
<tr>
<td>Iron, mg/100 ml</td>
<td>94</td>
<td>94</td>
<td>&gt;40</td>
</tr>
<tr>
<td>Cholesterol, mg/100 ml</td>
<td>238</td>
<td>256</td>
<td>&lt;250</td>
</tr>
<tr>
<td>Protein, gms/100 ml</td>
<td>7.4</td>
<td>7.2</td>
<td>&gt;6.5</td>
</tr>
<tr>
<td>Vitamin A, ug/100 ml</td>
<td>52</td>
<td>49</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

*Male value/female value
When asked whether they would spend more money on food if they had access to more money, 43 percent responded that they would. Nevertheless, only 2 percent of this group used food stamps.

**Dietary Intake**

As indicated by a three-day dietary record kept by each individual, energy requirements were not being met on the average (Table 1). About 7 percent of surveyed population had caloric intakes of less than one-half what is recommended by the US Nutrition Research Council. Paradoxically, though, when compared to the generalized ideal weight for height tables, 40 percent of the women and 20 percent of the men were overweight by 10 percent or more. Perhaps low energy expenditures are more of a problem than low energy intake. With the indicated short supply of calories, however, it would be almost impossible for an individual to obtain adequate amounts of the other essential nutrients.

Mean protein intake was exceptionally high. Only about 7 percent of the population had very low protein diets while 20 percent of the men and 5 percent of the women averaged over 100 gm of protein per day. With limited income and high protein foods being the most expensive it would seem that reduced protein intake is a dietary modification that may be very beneficial to a large number of the elderly.

Twenty-five percent of the men and 40 percent of the women were consuming less than 75 percent of their recommended daily allowance of calcium. This observation may reflect the intolerance to lactose that plagues some older individuals. Iron intake in the elderly is generally not a problem, due to the decreased requirement in the women following menopause. About 5 percent of the men and women did not achieve 50 percent of the recommended 10 mg per day of iron.

Vitamin intakes were generally adequate or in excess. Only 10 percent of the participants were getting less than the recommended level for any of the vitamins. These evaluations were based solely on foods consumed.
Table 2. Some health problems among Utah's rural elderly.

In addition, vitamin supplements were taken by 40 percent of the men and 48 percent of the women. This analysis indicates that the vitamin supplements were generally not needed.

As would be expected with a low energy and a somewhat low calcium diet, cholesterol intake was not excessive. Nevertheless, 40 percent of the men and 13 percent of the women were consuming over 500 mg per day.

Fiber intake tended to be low with 20 percent of all those sampled eating less than 3 gms of fiber per day. This may be due to the problems fibrous foods (whole grains, leafy vegetables, nuts) can present to people with dentures. Seventy percent of the population had either partial or complete dentures. The general lack of fiber in the diet may be a factor in the high consumption of digestive and laxative medications (17 percent of those surveyed).

Biochemical Findings

The mean values for all biochemical determinations were acceptable with the exception of serum cholesterol levels (Table 2). Higher than desirable serum cholesterol values were observed in 50 percent of the women and 33 percent of the men. Since dietary cholesterol intake was generally low, the serum levels may reflect the high incidence of overweight observed and may be associated with too little exercise and/or too much anxiety.

Recommendations for Elderly

This study showed that although nutrition is generally adequate, excess weight, high blood pressure and high serum cholesterol levels are problems for Utah's elderly. Other factors such as anxiety or stress can influence both blood pressure and cholesterol and, indirectly, weight. In many cases, physical exercise such as a block walk each day can be exceedingly beneficial.

About 5 to 10 percent of the elderly were deficient in one or more nutrients.
High protein foods could be used in smaller quantities and whole grain products increased thus giving some relief to strained food budgets. Inclusion of more fibrous foods (vegetables, whole grains, nuts) in the diet would also promote less reliance upon laxatives.

As food intake decreases, wiser choices must be made to insure adequate nutrients for the body. Pick foods with a high nutrient density, i.e. less cookies, soft drinks, etc. and more fresh fruits, vegetables and dairy products. Keep involved. It provides exercise, social opportunities and adds interest to life. These in turn create appetite, whereby we eat and obtain the nutrients our bodies need to maintain health and vigor.

A Temporary Transition . . .
Editor on Leave

Joan K. Shaw, *Utah Science Editor* since 1974, takes a short leave of absence beginning with this issue of the *Science*.

Having brought a new dimension to the content and look of *Utah Science*, Mrs. Shaw has, we believe, sought not only to present the most important current research in general audience terms but has revised the appearance of the magazine to make its articles attractive and inviting to the reader.

Not only does Mrs. Shaw guide the publication of *Utah Science*, she edits Agricultural Experiment Station Bulletins, Research Reports, various other research publications, and College of Agriculture and Experiment Station manuscripts for publication in professional journals.

Returning to school during her leave, she has received a Carnegie Foundation Grant to obtain a Doctor of Arts degree at Idaho State University, Pocatello, Idaho.

Mrs. Shaw will return to *Utah Science* in July, 1977. In her absence, the magazine will be edited by Lynne Paoletti, Assistant Editor.

— L. P.
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