AGRICULTURAL Research

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.S. DEPARTMENT OF AGRICULTURE

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Better foods

Homemakers have a lot to say about America's agricultural research. Not that they really *talk* much about it. What they do is to *buy*—or refuse to buy—the research-developed foods on the shelves of our remarkable American supermarkets.

Homemakers' buying habits are shaping three lines of research effort aimed at improving tomorrow's food products:

1. Research is building better qualities into foods right on the farm. Family-size turkeys and meat-type hogs were developed by scientists. Now they're exploring such possibilities as beef cattle with more lean. tender meat . . . dairy cows that give milk with more solids and less fat . . . potatoes with higher total solids and more vitamin C . . . and so on.

2. We're looking for ways of extending the market and storage life of perishable foods. Among the new methods are irradiation and antibiotics. Irradiation is being tried on nearly all the common foods. Research still has many questions to answer but we should eventually find irradiation-preserved foods on supermarket shelves. And we will have fresh foods with longer useful life as a result of irradiation combined with antibiotic or other chemical treatment before refrigeration. Antibiotics also show promise when used alone, as a supplement to refrigeration, in extending the life market of fresh foods. Two antibiotics have been approved for use on fresh poultry meat.

3. Consumers want seasonal foods all year—foods ready to eat and storable in the kitchen. These demands call for processing methods that convert crops into essentially new products. Frozen foods have been the major development of the last 15 or 20 years, and research will make tomorrow's frozen foods a great deal better than they are today. The next big development will probably come in concentrated products. Our scientists are developing fruit and vegetable products with all or part of the water removed and are now working on a dry whole milk (see page 3). Partial dehydration is being combined with freezing and canning to give us other excellent products.

Research—on our farms. in our factories, and in our supermarkets—has given us the abundance of good foods we enjoy today. And research will give us even better foods tomorrow.

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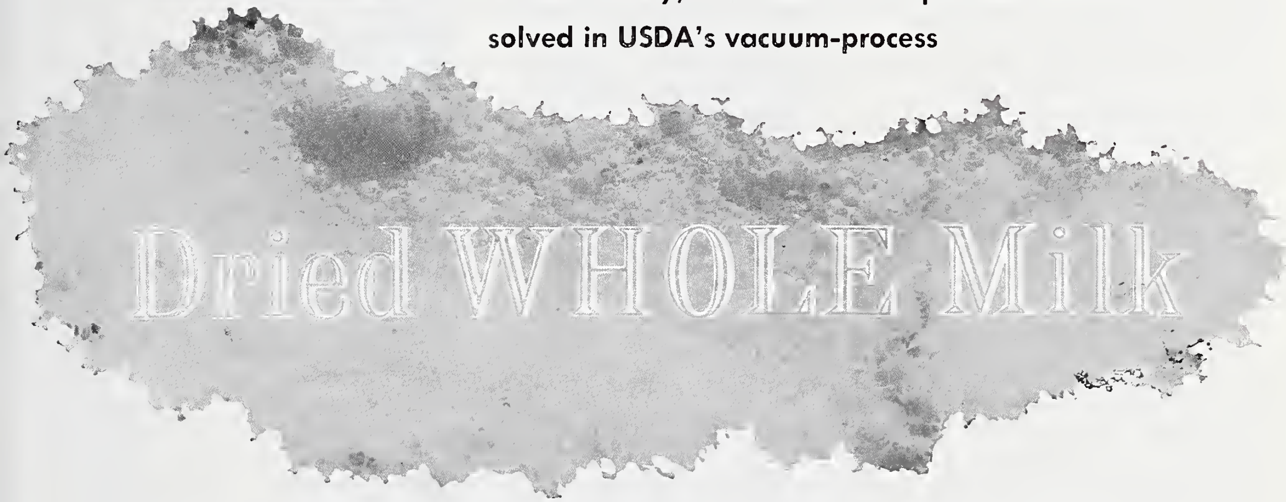
AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

A Progress Report

Fresh-quality whole milk in instant dry form is nearer reality now, after years of research. Better storability, commercial adaptation must be solved in USDA's vacuum-process

Dried WHOLE Milk



A DRY WHOLE MILK THAT RECONSTITUTES INSTANTLY, compares with fresh milk in quality, has long shelf life, and can be produced at prices that are attractive to consumers—this has long been the hope of the dairy industry in this country.

USDA has been working on the problem—as have others—and has developed a vacuum-dried whole milk that reconstitutes instantly into a high-quality product. So far, however, the product is bulky and its shelf life falls short of the need. Moreover, the process is still to be adapted to low-cost industry methods. These are major difficulties, and the product's prospects still depend on the outcome of further research.

Work is centered at the ARS Eastern utilization division in Philadelphia and Washington, D. C. Scientists at Philadelphia first devised a laboratory batch method to retain fresh milk flavor in a vacuum-dried whole milk that mixes easily and instantly, even in ice water. And the product, which looks like dry foam, goes nature one better. It keeps 2 to 3 months at room temperature, somewhat longer under refrigeration.

But laboratory success is only a beginning. Before foam-dried milk can be marketed, keeping quality at room temperature must be stretched to many months. Researchers must also change from batch drying to large-scale continuous production.

To understand how far development of the instant dry whole milk has come and how much still remains to be done, let's take a look at the characteristics that ARS scientists have built into their new product. Wholesomeness, flavor—the delicate flavor of fresh fluid milk—and good dispersibility are prime qualities of this foam-dried milk.

The vacuum process uses low temperatures that protect the milk's heat-sensitive fat and protein, essential to retaining the natural flavor and food value of whole milk. Because the concentrate is expanded with nitrogen gas and a minimum of air reaches the product under vacuum, oxidation is minimized. The unaltered protein and finely dispersed fat present in foam-dried milk also help it mix quickly and easily in water.

The complete process begins with the usual step for concentrating. Pasteurized and homogenized milk is first vacuum-concentrated to about 50 percent total solids, then homogenized in 2 stages under pressure of 4,000 pounds per square inch and 500 p. s. i. This breaks up fat globules more than in ordinary homogenized retail milk.

DRIED WHOLE MILK

(Continued)

At this point, the viscous concentrate is chilled (55° F.) and impregnated with nitrogen gas to cause the milk to foam as vacuum is pulled before the drying process begins.

Stiff foam structure forms

In the dryer, heat is not applied at first, because boiling at this stage would strip out the nitrogen gas and prevent formation of the desired foam structure. Instead, vacuum is pulled slowly, causing the nitrogen to expand the concentrate into a foam. Since evaporation is occurring slowly at this point, the foam is given enough rigidity to withstand the heat necessary for drying. Heat is then applied, and the foam dries to a stiff cake that's shot through with tiny, uniform bubbles. This fragile dry foam is screened into flakes and packed with nitrogen gas to provide material for storage tests that are now going on.

How does foam-dried milk taste? Before storage, it's as good as fluid milk, according to the scientists. But the "fresh" taste doesn't last. The milk picks up off-flavors and begins to stale after 9 to 12 weeks at room temperature. It retains its good flavor somewhat longer, however, when stored under refrigeration.

Flavor changes unexplained

Why the flavor changes during storage is not fully known. To find out more about specific chemical compounds causing off-flavor and about the effects of processing on staling, ARS scientists in Philadelphia and Washington are following chemical and engineering leads. The aim is to avoid staling and prevent development of off-flavors. But work in the chemistry of flavor changes has not yet gone far enough to point the finger at specific causes.

SELF-MIXING in ice water took 4 minutes for USDA milk. Most spray-dried whole milk (left) caked at surface.

FOAMY structure of vacuum-dried milk (upper) is uniformly expanded to give good dispersibility. Caked spray-dried milk (lower) may not liquefy.

BATCH of whole-milk concentr just out of vacuum dryer is greatly expanded and resemble mass of foam. This is one of 300 batches made by this proce

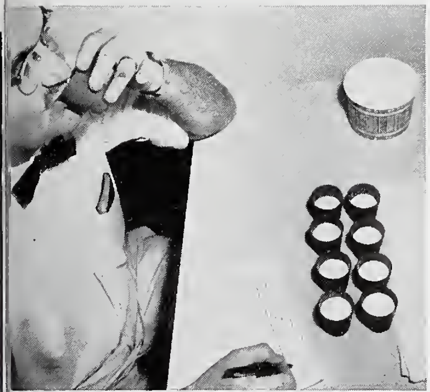
One suspect is the fatty material called phospholipid that coats milk-fat globules. Agitation during processing causes this outer fat to disperse through the milk serum, a migration that may lead to oxidation in the stored product. Another experiment uncovered a milk enzyme that splits the fat-protein complexes. Scientists think this enzyme may act as a catalyst in flavor changes.

Work on carbonyl compounds—aldehydes and ketones that form as dry milk oxidizes in storage—is another trail being followed in the chemistry of flavor changes. A new and more effective method was worked out for extraction of aldehydes from milk. That enables researchers to analyze the aldehydes and uncover vola substances in extracts from m stored at high temperatures to sp up the rate of oxidation. The ex role of the substances is under stu

Lactose, free fat studied

Experiments are under way to fi whether flavor stability is affected free fat—that amount of the wh that can be separated out by orga solvents. The physical state of l tose, whether crystalline or glas may also affect flavor. But work lactose and free fat is not far enou along to report.

The scientists are now working a changeover from batch drying modified commercial belt dryi



ʼTE PANELS regularly criticize new k's flavor and help guide work of engineers l chemists in improving laboratory process.

NON-POWDERY whole-milk flakes keep their excellent dispersibility for as long as a year. Flakes have stable fat and natural protein, keep fresh flavor for 3 months. Staling and excess bulk are problems still to be solved.

thods are being tested for feeding gas-impregnated concentrate into vacuum chamber and forming the ired foam structure. For best re-s with the new equipment, scien-s are studying numerous process variables and their interrelation-). These include vacuum and rate heat application in the dryer as l as the concentrate's temperature. cosity, and amounts of solids and that give best results.

st, market to be checked

Engineers will figure what it costs produce this new instant dry whole k after continuous-belt-drying pro-ures are finally worked out. And, course, researchers want to know at consumers think of it. ☆

RECLAIMING RADIOACTIVE SOIL

■ AN EXPERIMENTAL "FARM" at USDA's Agricultural Research Center Beltsville, Md., is being worked for a special kind of yield. This farm is a radioactive test area set up by researchers. It is being used to yield information as to the best ways of removing surface contamination in the event we are faced with dangerous radioactive fallout.

Accidental contamination, and fallout from enemy atomic or hydrogen weapons are potential dangers. They would have to be met promptly to safeguard lives and keep valuable farm land safe for food production.

ARS soil scientists and agricultural engineers set up the tests under contract with the Atomic Energy Commission. In the first test, the isolated area of about one-third acre was sprayed with a low concentration of barium 140. It is relatively short lived (average life, 18 days), thus will free the same plots for future tests. Experience with barium 140, however, will teach us how to deal with other types of radioactive particles that remain dangerous for months or years.

First test in the series simulated a variety of crops and land uses. This investigation dealt with the most effective removal of typical broad-leaved and narrow-leaved field crops (soybeans and Sudan grass), mulches of various thickness, stubble, and ordinary sod.

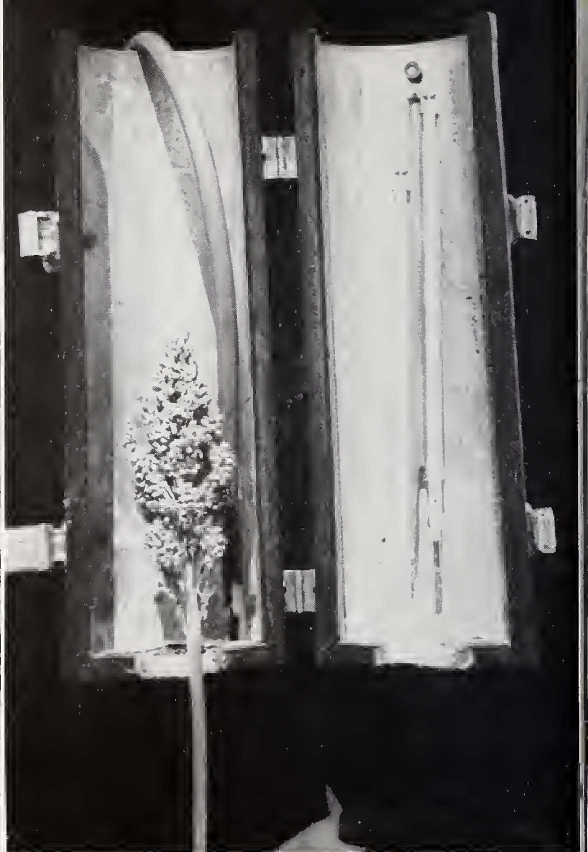
Plots were each sprayed with about 140 microcuries of barium 140. Crops, mulches, stubble, and sod were removed the same day, and the radioactivity of cleared plots was measured immediately.

No removal method eliminated all radioactivity. Raking and removing heavy and medium mulches from the plot cleaned up nearly all radioactivity, though a little more was left on the soil from light mulch. Cutting and rolling sod and removing it was about as effective as removing light mulch. When the top layer of soil and stubble was flail-chopped and picked up in a chute-delivery bag, a larger amount of radioactivity was left on the plot. More than two-thirds of the radioactivity was left when plants were mowed and collected in a bin attached to the mower. Plants and soil taken from test plots were collected in windrows or piled at the field's edge until they were safe.

Future tests will evaluate decontamination methods under a variety of land conditions and different systems of land management. Removal of radioactivity will be tried on different kinds of soils and types of land surfaces, on standing crops of varied growth, and different mulches and stubble. The scientists will also try decontaminating surface soil by spraying the soil with emulsified asphalt, letting it harden, then scraping it off to pick up the radioactive surface layer. ☆

Easy Way to Breed SWEET SORGHUM

New device speeds up variety improvement



JOINED HALVES of cylindrical cup can be closed around head of sorghum plant, with stem extending through opening in bottom of cup (right). Tight seal is formed when halves are closed (above). Cup is 3 inches wide, 12 inches long, adjustable to any height for field or greenhouse work.

■ A NEW DEVICE for emasculating the multitude of flowers in a sweet-sorghum panicle (seed head) with hot water has considerably speeded up USDA variety improvement work on this crop in California.

This simple innovation meets a critical need for a fast and easy way to kill plant pollen in the field and greenhouse, and speeds up the tedious job of making numerous crosses. Although developed specifically for sweet sorghum, the device should work equally well with other plants where the pollen is killed at a temperature that won't affect the ovary. With this device, sweet-sorghum pollen is killed after 10 minutes immersion in water kept in the temperature range of 107° F. to 111° F.

Basically, the equipment consists of two joined halves of a cylindrical cup adjustable to any height on a ringstand for pollination work in the greenhouse or on a metal rod driven into the soil beside a chosen plant in the field. The halves are joined by hinges at the back and metal straps at front. ARS agronomist Charles Price at Salinas, Calif., developed the device.

Old treatment was effective but difficult

Flower emasculation by hot water is common practice in sorghum breeding. Pollen-bearing stamens are destroyed without injury to the vital pistils, if water temperature is kept at a safe level—107° F. to 111° F. Heretofore, sweet-sorghum plants grown in a greenhouse were taken to a laboratory, tilted, and the heads dipped and held in hot water of desired temperature. In the field, it was necessary to bend the plants, so the heads could be dipped and held in a thermos jug of hot water.

New method is faster and more efficient

Now the method is much simpler. The head of the sorghum plant is placed between the two halves of the cup, which is 3 inches wide and 12 inches long. The cup is cut longitudinally with matching slots in the base of each half to provide a circular opening three-fourths inch in diameter when the cup is closed.

Then the two halves are closed around the head with the stem extending through the opening in the base of the cup. A layer of sponge rubber around the edges of each half of the cup forms a tight seal when the halves are closed. But cotton is usually wrapped around the stem to adjust for differences between size of the opening and stem diameter of various plants treated.

A thermometer placed in the emasculator can be read from the top of the cylinder. Then hot water is added. Temperature must be checked frequently and more hot water added to keep temperature at the desired level. ☆

How to Manage NAPIER GRASS

■ YIELDS OF NAPIER GRASS, one of the most widely used tropical grasses, can be greatly increased by nitrogen fertilization and longer harvest intervals. But *too long* a harvest interval leads to poor-quality forage.

Cooperative research by USDA and the Agricultural Experiment Station of the University of Puerto Rico is showing how we can juggle nitrogen fertilization and harvest interval to obtain not only high-quality forage but also high yields and easy management. Studies show how the season affects the response of Napier grass to nitrogen fertilization, and how nitrogen fertilization affects forage composition and soil acidity.

Potential yield is tremendous

Research over 3 years indicated that the best compromise was 800 pounds of nitrogen per acre yearly, with a 60-day harvest interval. Under these conditions, Napier grass yielded 44,561 pounds of dry matter per acre per year—about 130 tons of green forage—with 9.7 percent protein. This is enough roughage for more than six mature cows or steers.

With this treatment, however, the grass took huge amounts of nutrients from the soil—674 pounds of nitrogen, 554 of potassium, and 120 each of calcium, magnesium, and phosphorus per acre yearly. Nutrient withdrawal rose with more nitrogen and longer harvest intervals.

Researchers Jose Vicente-Chandler, Servando Silva, and Jacinto Figarella of Puerto Rico applied up to 2,000 pounds of nitrogen per acre yearly on test plots. The grass was cut every 40, 60, or 90 days.

Forage yields increased rapidly at all harvest intervals and at all seasons as nitrogen was upped to 800 pounds. Protein content increased as nitrogen was raised to 2,000 pounds per acre, reaching a high of 17.6 percent when the grass was cut every 40 days. Total protein per acre also increased with nitrogen fertilization up to the 2,000-pound rate.

Phosphorus and potassium content of the forage fell considerably with higher nitrogen. Calcium and magnesium stayed about the same. Lignin, however, rose with more nitrogen.

Highest yields were obtained when Napier grass was cut every 90 days. But the forage was low in protein and minerals and high in lignin. On the other hand, quality was excellent with a 40-day harvest interval. But yields were low, good stands were difficult to maintain, frequent weeding was necessary, and harvesting costs were higher. Researchers felt that a 60-day harvest interval was a good compromise. Along with this, yearly applications of 800 pounds of nitrogen per acre proved economical.

Overall forage yields stayed much the same during the 3 test years. But seasonal yields varied by as much as 70 percent from the average. Researchers suggest that such variations could be kept within a 30-percent range by using a longer harvest interval and more nitrogen during seasons of slow growth, and a shorter harvest interval and less nitrogen during seasons of fast growth. Slower growth occurred early in the year with shorter days and cooler weather.

Higher acidity calls for lime

Heavy applications of ammonium sulfate as a nitrogen source had a tremendous effect on soil acidity. For instance, application of 800 pounds of nitrogen (2 tons of ammonium sulfate) per acre yearly for 3 consecutive years reduced the pH of the upper 6 inches of the soil from a neutral 7.0 to a highly acid 4.1. The reduction in pH was even greater with more nitrogen, affecting the base status of the soil to a depth of 2 feet. To overcome this effect, limestone should be applied yearly. ☆

New Soybean for North Central Area

■ A NEW HIGH-YIELDING SOYBEAN, Shelby, adapted for growing in Indiana, Illinois, and Missouri, has been developed at Urbana, Ill., and released for seed increase by researchers of USDA and North Central States agricultural experiment stations.

Shelby is similar to Lincoln in height and lodging resistance, equal in oil and protein content, and tends to be better in seed quality. Shelby has outyielded earlier-maturing varieties such as Hawkeye, Adams, and Harosoy except in certain tests in the northern parts of the three States. In the central and southern parts, Shelby yields less than Clark but is 6 days earlier.

The new variety was developed by selection from the backcross of Lincoln with a Lincoln-Richland cross made 16 years ago at the Illinois Agricultural Experiment Station.

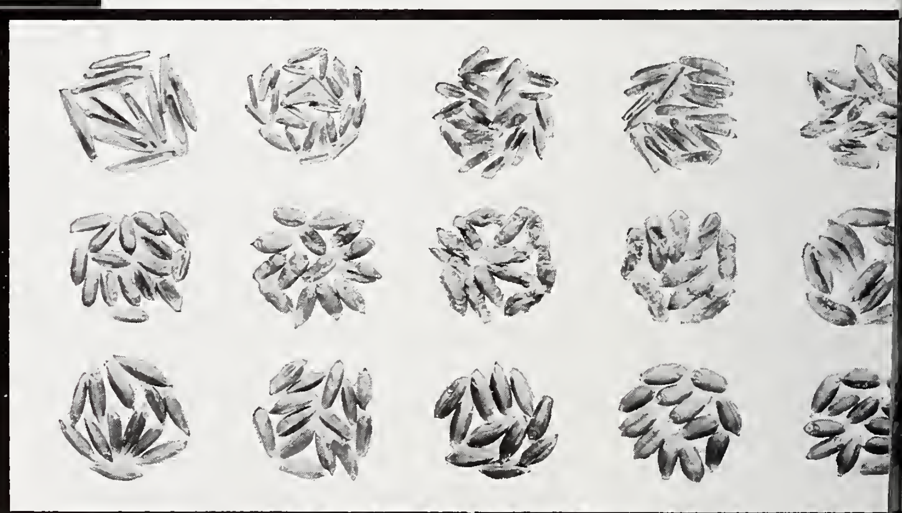
Certified-seed growers can obtain seed of Shelby for increase in 1959. There should be enough seed supply for extensive planting by growers in the three-State area in 1960. ☆

W. J. SANDO bags his intergenus hybrids, on which he has just placed wheat pollen. It takes patience to relay grass genes into wheat.

Thirty-five years of intergenus crossing has given us superior qualities for wheat, potentials for conservation, forage in

EXPERIMENTAL GRASS-WHEAT HYBRIDS

CLUMPED spikelets and seeds adhering to husks are common fault of hybrids (below); wheat (top) must thresh clean.



EVOLUTION of the grass-wheat hybrids shows in the samples of seed produced by crossing two ancestors—agropyron (in hulls and hulled, first two, top row) and commercial wheat (lower right).

■ OUT OF GRASS-WHEAT CROSSES studied by USDA and State agricultural experiment stations for 35 years have come lines that combine many useful characters. These include disease and insect resistance, drought tolerance, and a measure of perennial-growth habit.

So far, no commercially important perennial hybrid wheats have been developed. But the hybrids figure importantly in breeding desirable qualities into wheat.

The hybrids came from work begun in 1923 by ARS agronomist W. J. Sando (retired), who crossed wheat with *Agropyron elongatum* (wheatgrass), *A. trichophorum*, and others at the old Arlington (Va.) station.

The *Agropyron* genus was selected as breeding material because Sando believed it offered winter hardiness. He made little progress in getting this into wheat, but found useful disease and insect resistance to transfer.

It took 12 years of determined effort to create the original crosses, 40,000 pollinations of these to obtain a handful of seeds, and 23 years of further breeding to bring about the present encouraging hybrids.

Some of the first-generation wheat-agropyron crosses have lived for 17 years, but they are more like giant grasses than wheat. Sando made thousands of backcrosses to wheat and intercrosses to transfer disease and insect resistance from agropyrons to wheat. His perennials have not lived beyond the fifth year and have become progressively less productive after the first year.

Sando sent his original hybrids in 1937 to more than a dozen American cereal breeders. Among them was ARS agronomist C. A. Suneson, engaged in cooperative work with the California station at Davis. Primarily interested in developing wheats with the perennial habit of the hybrids, Suneson backcrossed them to spring wheat and intercrossed the progeny. He has developed what he believes to be a true perennial wheat that might lead to a commercially available wheat in a few years.

SIX SPIKES representative of new hybrid perennial wheats (right) for California have more seeds per head than State's two leading spring wheats (typical heads shown at left).

Short-lived perennial looks good

Suneson's present perennial hybrids have a life of about 4 years under conditions at Davis, with progressively smaller yields after the first year. In recent tests, two perennial wheat-agropyron selections at Davis yielded as well as the best local wheats in the first crop. With no weed control or fertilization, the second yield was at least 40 percent less. Subsequent yields were much lower. Management of the crop by weed control and fertilization after the first year has not been solved. These practices may, however, hold a key to increasing yields for the second through the fourth year.

Sando believes that crosses of wheat with agropyron offer greatest promise from the standpoint of disease and insect resistance, drought tolerance, and protein increase in the overall improvement of wheat.

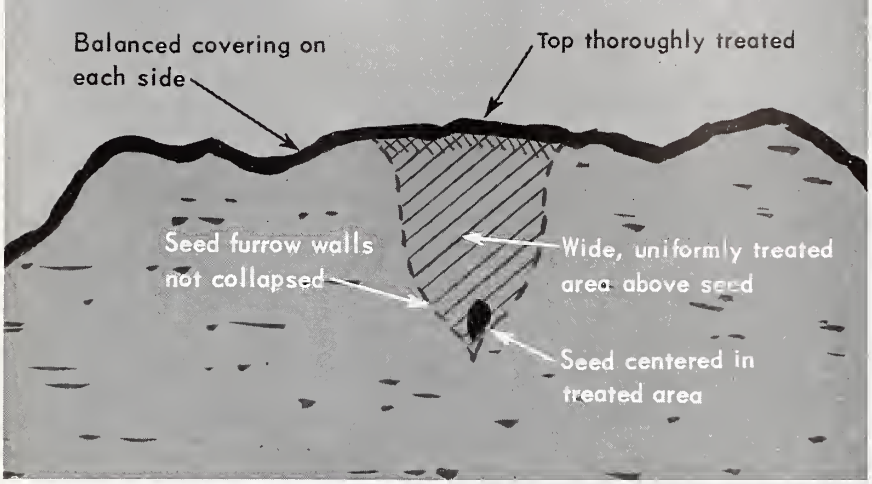
Some hybrid plants have superior disease resistance. Some inoculated with 13 races of stem rust, for example, gave no reaction to 12 of them and only a trace of infection from the thirteenth. In certain tests, other plants have shown high resistance to leaf rusts, yellow-dwarf and streak viruses, mildew, smut, and septoria blotch. Some leaf-rust-resistant selections at the Oklahoma station look particularly promising. Certain other selections have shown outstanding resistance to insects such as hessian fly, joint worm, and aphids.

High-protein flour was produced from one selection. And in a baking test, this high-protein flour produced some highly satisfactory loaves of bread.

Weakness still must be bred out

Sando stresses that much work still needs to be done with these plants. Along with the desirable disease and insect resistance, drought tolerance and long life, some selections have undesirable characteristics such as low test weight of the grain, fragility of the rachis (spike), seed tightly enclosed by and attached to the husk, loosely constructed seed heads, and sterility.

It's planned to continue incorporating the good qualities and dropping off undesirable ones from the agropyron-wheat crosses. Sando and Suneson believe vastly improved wheats can be bred from these valuable crosses. And the prospects are encouraging for wheat that will protect the soil and, under favorable conditions, give forage following a normal grain crop. ☆



COVER DIRT, treated with fungicides (diagram), gives safe bed through which seedlings rise to surface. Attachments on planter (photograph) completely treat and place the furrow cover. Dust is delivered into covering soil through seed-drop tube (right) and by "Y" connection to rear of seed-firming wheel (center) to mix with upper soil and seed-row surface.

SAVING COTTON SEEDLINGS

Proper soil treatment, with thinner spacing, saves young plants from destructive fungi

■ COTTON SEEDLINGS CAN be saved from soil-borne fungi by effective soil treatment at planting.

Mixing fungicides well in the furrow—around and over the seed—walls out attacking pathogens and lets seedlings escape to the surface.

USDA cooperated with the Texas Agricultural Experiment Station in developing placement and mixing methods that cut losses sharply and improved stands more than two-thirds. Effectiveness of the treatment is increased by another planting practice—thinner spacing of seed to make it harder for fungi to spread.

The method field-tested in Texas treats a band from the seed zone to the soil surface—rising from a base three-eighths of an inch wide to 2 inches at the top. The furrow's top layer also gets a thorough fungicide dose to protect emerging seedlings. ARS plant pathologist C. D. Ranney, working with A. M. Hillis, of a commercial chemical company, found that planting equipment can be adapted to give the band needed coverage.

Planter attachments meet need

First of all, the planter is equipped with V-wings wide enough to control the flow of soil past the furrow opener. Next, a runner-type opener is used if practicable. It firms the furrow walls and allows covering devices to crumble only treated soil into the furrow. A narrow-bottomed pener on the planter keeps the seed rom shifting from the middle of the rea treated. Fungicide is applied oth ahead and behind a seed firming heel when such a device is used.

Tests also showed that disks, poons, shovels, or drags used for nal covering may squeeze the treated rea if not properly adjusted. Squeez-ıg causes uneven coverage or uneven lling and sometimes scatters seed to ıe edge of the treated area. To avoid ıis, soil flow is balanced along each de of the furrow, and depth and ngle of covering devices adjusted to revent compressing furrow walls.

Fungicides are equally effective pplied as spray or as dust.

tandard sprayer can be used

In applying spray, low-pressure ower equipment can easily be dapted. A regulator is installed to old pressure at 35 to 40 pounds per quare inch. Nozzle size varies with anting speed — generally, larger ozzles are used at higher speeds. he front nozzle is centered on the ırrow so that spray strikes the soil ound the seed and 3 inches on each de of the furrow. Spray from the ear nozzle is directed into soil thrown to the furrow by covering devices.

In applying dust, delivery tubes eed high air velocity to prevent clog-ng. But an attachment to reduce elocity at the outlets will expose ore covering soil to the dust and event drift and loss of fungicide.

Texas plant pathologist L. S. Bird ıd agronomist Levon Ray demon-rated that thinner spacing of seed lds to the effectiveness of soil treat-ent in controlling soil-borne fungi. ender living tissue such as a cotton edling is readily used by fungi as a urce of energy to propel their owth through the soil. Thinner acing—an optimum seeding rate of out 25 to 30 pounds of acid-delinted ed per acre—stymies diseases and duces field damage. ☆

One Pasture—Two Purposes

PUBESCENT wheatgrass with alfalfa gave best gains on lambs in grazing comparisons of a number of forage combinations grown in the Wyoming study.

■ LIVESTOCK IN THE WESTERN SHORTGRASS plains can have lush grazing in the fall—then, in the following winter, have plenty of hay that was harvested the preceding summer from the same pastures. The doubled fare would come from planned dual-purpose pastures. To test the practice, USDA cooperated in seeding trials conducted by the Wyoming Agricultural Experiment Station, at Archer, from 1951 through 1955.

Success depends mainly on types of grasses used in the pastures, researchers found. For these studies, ARS soil scientist Frank Rauzi, Wyoming agronomist R. Lang, and Federal-State soil scientist O. K. Barnes selected intermediate wheatgrass, pubescent wheatgrass, Russian wildrye, and crested wheatgrass. Each was seeded in combination with alfalfa in separate pastures, and intermediate wheatgrass was also seeded alone. All were cut for hay in late June. Beginning October 1, ewe lambs grazed the regrowth an average of 50 lamb-days per acre. A native pasture was grazed during the same period.

The pasture seeded to crested wheatgrass combined with alfalfa yielded most. The average of 655 pounds per acre was much larger than yields from Russian wildrye and alfalfa, or from intermediate wheatgrass alone. What's more, only yields from the crested wheatgrass pasture consistently increased during the 5-year test period.

Lambs on pubescent wheatgrass and alfalfa made the best gains. The 5-year averages were 13.2 pounds per head and 16.5 pounds per acre. Grazing capacity was particularly good after the third year, when the alfalfa had largely taken over. Lambs gained much less on crested wheatgrass and alfalfa, as well as on the native pasture.

Seeded grasses for the most part had higher crude protein content than native grasses in the fall samplings. Russian wildrye, a drought-resistant bunch grass better adapted for pasture than for hay in this area, had the highest protein content of the seeded grasses. ☆

Even Better

PLASTICIZER—the distilled animal fat derivative—is simply added to the powdered plastic, vinyl chloride.

BLEND of plasticizer and vinyl chloride is deposited between the hot rollers to be made into a sheet of plastic.

This new way of using fatty plasticizers fuses them internally into the plastic's chemical structure. As a result, better plastics are being made and a new outlet created for animal fats

■ PLASTICS ARE BEING GREATLY IMPROVED, by *building into them* chemically modified animal fats.

USDA scientists are actually hooking molecules from these fats into certain of the long-chain carbon compounds of which plastics are composed. The result is a high-quality, strong, flexible plastic. This could provide an additional use for surplus animal fats.

The modified fats thus serve as plasticizers, materials used to convert plastics from hard, brittle substances to soft, flexible, tough materials that can be easily processed into durable, high-quality products.

When these modified animal-fat molecules are built into the chemical structure of the plastic, they are *internal* plasticizers. When the molecules are simply added to the previously formed plastic without actually becoming part of the chemical structure, they are *external* plasticizers. With wear and tear, these external plasticizers tend to evaporate, wash out, or migrate, and the plastic reverts to its original brittle and horny state. This doesn't happen with internal plasticizers, which are permanently fixed into the plastic's chemical structure and can't evaporate, wash out, migrate, or otherwise lose their effectiveness.

The discovery of internal plasticizers resulted from some precise chemical sleuthing by chemist Daniel Swern and his associates at the Eastern utilization division, Philadelphia, Pa. A few years back, they found that a special kind of chemical joining (copolymerization) of an animal-fat derivative with simple chemical compounds produced plastics that were *internally* plasticized.

The chemists first found that a material called vinyl stearate had the most promise as a softening agent for plastics. The "stearate" comes from animal fats; the "vinyl" from acetylene. Making vinyl stearate from these raw materials proved to be fairly easy, although the product from the earlier trials wasn't pure enough for the intended use. In later efforts, however, the obstacle was overcome through careful operation of the steps leading up to the synthesis of vinyl stearate.

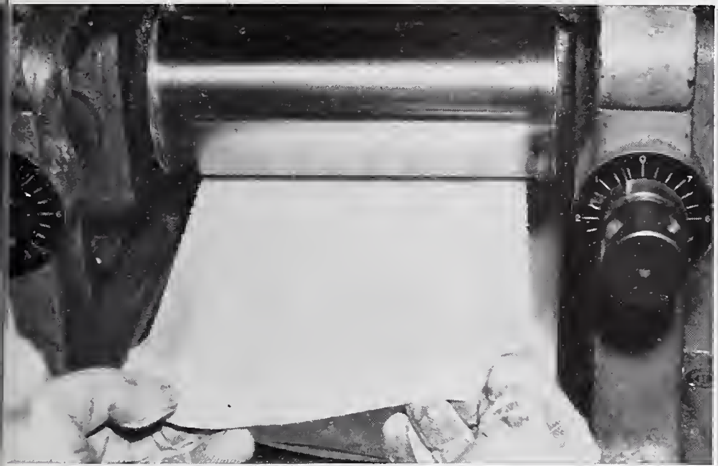
One large chemical firm has now started to make vinyl stearate on a scale of some 2 million pounds per year. This is small by chemical industry yardsticks, but both the manufacturer and ARS scientists are confident that demand for this new product will grow.

How and why do plasticizers function as they do? First it's necessary to know that plastics are composed of polymers—giant chemical molecules of high molecular weight. These polymers can be synthesized through simple chemical procedures to make the base plastic. The starting materials are small reactive molecules, called monomers. A common monomer is vinyl chloride. Monomers have one property in common—they can be induced to join with each other in long chains, much as individuals at a dance join hands in a "Paul Jones."

Chains are linked together by plasticizer

This joining into chains is called polymerization and results in a large molecule called a polymer. Polyvinyl chloride is one of the most important base polymers. The binding forces between polymer chains are mostly responsible for the stiffness and high melting point of many

Plastics From Fats



SHINY plastic sheet comes off rollers. Plastics with built-in animal fats are stronger, more flexible, and more durable in temperature extremes than plastics we've made heretofore.

FATTY plasticizer fused or linked internally in the plastic's chemical structure (top) can't escape. But a plasticizer merely mixed with plastic (below) gets out.

plastics. These binding forces vary in number and strength from polymer to polymer.

Plasticizer relaxes, lubricates a plastic

A plasticizer reduces or overcomes the intermolecular forces of attraction by placing itself between the chains, increasing the distance over which these forces must operate. So instead of the rigid long-chain-to-long-chain bonds in the chemical structure we have flexible long-chain-to-plasticizer bonds.

The plasticizer also acts as a lubricant, allowing the chains to slide past each other more easily. Thus a plasticizer gives greater flexibility to the molecule at lower temperatures. This is why your plastic rubber hose doesn't crack or break in cold weather as it might have when rigid plastics first came out many years ago.

External plasticizers are oily materials that are simply mixed in mechanically with the base polymer. Internal plasticizing with vinyl stearate is a triumph of chemists' imagination and skill. The stearate end of the plasticizer is the "oily" end and does the plasticizing. The vinyl end reacts like other vinyl monomers, and joins up with them in the polymerization step. Since more than one monomer is thus involved, the joining up process is called copolymerization and the product is a copolymer. In the copolymer the oily end is chemically—and hence permanently—bound to the long chain.

Untreated fats do not react or mix well with vinyl polymers such as polyvinyl chloride. ARS chemists have found that treatment of animal fats with hydrogen peroxide yielded complex compounds know as epoxidized derivatives. These mixed well with polyvinyl chloride and acted as stabilizers and external plasticizers—imparting flexibility, and resistance to heat, light, and oil.

These earlier findings have led to the manufacture of epoxidized fats by many companies, using about 30 million pounds of fats yearly. Fats so treated are being used in growing quantities in many vinyl plastics—rainwear, shoe soles, shower curtains, wire and cable coverings, floor coverings, and many others.

New use could offer a large outlet for fats

But whether they are external or internal, animal fats offer many advantages for plasticizers. The raw material is cheap, chemical modification is simple, plasticizer yields are high, and there are no undesirable byproducts. The double-barreled role for animal fats suggests that a potentially huge outlet for them could be developed in the chemical industry. ☆

LARD-FED TURKEYS MAKE GOOD EATING

■ ADDING 8 PERCENT LARD to a turkey ration resulted in birds that cooked to a rich, even brown and scored high in all the quality characteristics measured by USDA home economics and poultry researchers. These turkeys rated higher in flavor of thigh meat than those on other rations and had little or no off-flavor or off-odor.

ARS poultry scientists had found earlier that turkeys which received the same ration gained more weight per pound of feed consumed and had a higher finish when marketed than turkeys eating no added fat (AGR. RES., September 1956, p. 13).

For the palatability tests, food specialists Alice M. Harkin, Carroll Kitzmiller, and Gladys L. Gilpin, in the Institute of Home Economics cooked over 100 turkeys by standard methods. The meat was evaluated by a taste panel for flavor, off-flavor, tenderness, and juiciness. Tenderness was also mechanically determined with shear instruments and juiciness by the percent of moisture extracted with a laboratory press.

The 8-percent lard ration—including vegetable protein and dry vitamins A and D—was 1 of 7 fed to groups of hen and tom turkeys by poultry scientist S. J. Marsden. Other diets using a vegetable protein and 4 percent lard were supplemented by vitamin A and D oil or dry vitamins A and D. Animal-protein rations containing 5 percent menhaden fish meal were supplemented with vitamin A and D oil, with vitamin A and D oil plus 4 percent lard, with dry vitamins A and D, or with dry vitamins A and D plus 4 percent lard.

All the turkey meat samples scored slightly full to full in flavor. Thigh meat showed somewhat greater range in flavor than breast meat. The most off-flavor—described as fishy—was noted in thigh meat from turkeys fed the ration containing menhaden fish meal and vitamin A and D oil. Flavor and off-flavor of breast meat and off-flavor of skin were not significantly affected by ration.

Ration also had little effect on tenderness and juiciness as measured either by scores or by instrument tests. All samples were tender to very tender and all thigh meat was juicy, although some breast meat was slightly dry. Meat from turkeys fed animal-protein rations with added lard tended to be juicier.

The method of cooking did not seem to affect the quality of the meat. Some birds were roasted uncovered at 325° F. Others were braised in a covered roaster without added water in an oven set at 450° F. and uncovered to brown during the last 30 minutes of cooking. The roasted turkeys had better appearance, but they took longer to cook to the same degree of doneness. Care must be taken in cooking young birds as a little overcooking makes the meat dry. ☆

What Our Forest Trees Are Like

■ INFORMATION ON CHARACTERISTICS of some 100 important forest trees of the United States is being assembled by USDA's Forest Service. Silvical data for each species include a description of where it grows, conditions favoring best growth, reproductive and growth habits, races, hybrids, and special features.

Such material is useful to foresters or others growing the trees in their natural environment or as introduced trees, and also to entomologists and pathologists studying pests of trees.

Foresters are preparing reports on individual species. These reports bring together all the available information from a variety of publications and unpublished sources including Federal and State agencies, schools, and forest industries.

Nearly all of the reports have been completed and about half of them published by the forest experiment stations. The reports will be a basis for a comprehensive manual, which will be a companion volume to "Woody-Plant Seed Manual" (Miscellaneous Publication 654, 416 pp., 1948, Superintendent of Documents, Government Printing Office, Washington 25, D. C., $4.) ☆

New Gila safflower

A new safflower variety resistant to ɔhytophthora root rot and rust has ɔeen developed by USDA and the Arizona Agricultural Experiment Sta-ion as a replacement crop to grow ɔn irrigated land in the Southwest.

This relatively new oilseed crop is gaining importance because its oil can ɔe used in paints and varnishes with-ɔut causing them to yellow.

Gila, the new variety, is equal or superior to variety N–10 in yield, oil ɔercentage, and seed weight. It ma-ures about the same time as N–10, ɔrincipal safflower variety now grown n dryland areas of California.

Enough seed has been released to seed growers to plant about 600 acres o Gila in December for increase. This should provide enough seed for com-nercial planting next year. Infor-nation on seed sources is available rom the Arizona Agricultural Experi-nent Station at Tucson. Seed will ıot be distributed by USDA.

Gila originated at the Agricultural Research Center at Beltsville, Md., from a cross between N–10 and WO–14 safflower varieties, backcrossed once to N–10. Selection and seed ncrease were done at the Mesa, Ariz., ield experiment station. Gila has ɔeen tested at various locations in Arizona during the past 4 years and s currently being tested for adapta-ion in the northwestern and northern Great Plains States.

Growing grafted dogwood

Pacific dogwood, native of the West Coast, may soon be adapted for ɔreeding and display on the East Coast, home of flowering dogwood.

The western species has bracts ("flowers" to most people) a third to a half larger and more abundant than in eastern dogwood. The flowers are also slightly oblong and sometimes faintly tinged pink. So, growing both species would provide variety in showiness, form, and color.

To move eastward, the western dog-

wood must adjust its tops to eastern temperature, light, humidity, and wind conditions, and its roots to eastern soil structure, aeration, water content, nutrient supply, temperature, and related factors. To meet this need, geneticist W. F. Kosar, of the National Arboretum, Washington, D. C., and other USDA scientists are evaluating vegetative propagation.

Kosar grafted 10 scions of Pacific dogwood from University of Pennsylvania's Morris Arboretum onto 3-year-old seedlings of eastern dogwood.

Preliminary results show this removed many of the limitations. First season's growth of 2 grafts (from the bud union to the terminal bud) averaged 43 inches. New growth survived temperatures as low as 1° F.

Stockmen alerted on fly

Screwworm flies have been found in isolated areas recently, underscoring USDA's plea to southern stockmen to report promptly any attacks of this pest on their animals. A quick report to the county agent, accompanied by a specimen, could help officials bring the fly under control.

State and Federal officials are conducting a campaign to eradicate screwworms from the entire Southeast (AGR. RES., July 1958, p. 8). Infestations not discovered or reported immediately can seriously threaten the success of the campaign.

Although the infestation is concentrated in Florida, 2 cases were found in the southern part of Georgia early in the summer and 2 others recently in Alabama. Control measures were applied in these cases.

The eradication effort under way in the Southeast is based on the fact that when a female screwworm fly mates with a sterile male she produces only infertile eggs. Flies are sterilized by radioactive cobalt, a product of atomic-energy research. Continued release of sterile flies in an infested area eventually eradicates the species.

Two wheats for Northwest

Two improved hard red winter wheats, Columbia and Itana, have been developed by USDA and the Oregon, Washington, Montana, and Idaho Agricultural Experiment Stations for southern Idaho. Columbia is also recommended in Washington and Oregon, Itana in Washington and Montana.

Both varieties are superior to Wasatch, Cache, and Turkey in yield, quality, and smut resistance and should replace much of their acreage. Both new varieties have outstanding resistance in the field to common smut, although Itana reacts moderately when artificially inoculated with some races of this disease. Seed treatment is still recommended as a precaution. Dwarf bunt attacks these varieties under some conditions.

Winter survival and spring recovery of both varieties have been good under Idaho dryland conditions, except for damage by snow mold. Yields have been consistently higher than those of other recommended varieties of hard

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red winter wheat. Itana has outyielded all other varieties by amounts ranging from 2.2 bushels over Columbia to 7.7 bushels over Wasatch. Columbia and Itana show good to excellent milling and baking qualities.

Tenderness in poultry

Aging poultry at least 12 hours before freezing it improved tenderness in recent research by USDA's Western utilization division, Albany, Calif., and other agencies. Moreover, the studies showed that birds aged *before* being cut up were more tender than those aged *afterward*.

Severe scalding—above 125° F.—and mechanical picking both interfere with normal tenderizing, but tenderness will not be harmed in machine picking if beating is minimized. Tenderization proceeds slowly at 27° F. but virtually stops at zero.

Stabilizing guacamole

A combination of waxy-rice flour and sodium alginate has been found to reduce the watery separation in frozen guacamole. That is mashed

avocado flavored with lemon or lime juice, onion powder, and salt.

Separation of water from the solids of the avocado flesh when thawed does not affect quality or flavor, according to scientists of the U. S. Fruit and Vegetable Laboratory at Weslaco, Texas. However, the researchers point out that the separation makes the guacamole appear unappetizing and thus prevents the use of certain fruit varieties and strains.

Research with waxy rice at the ARS Western utilization division at Albany, Calif., solved the problem of watery separation in many precooked frozen food products such as gravies, sauces, and puddings (AGR. RES., April 1954, p. 11). Waxy-rice flour used alone altered the taste of guacamole. To overcome this, scientists substituted sodium alginate for part of the stabilizing agent.

Aid to beet processors

The moisture content of sugar-beet pulp can be estimated by the dichromate heat-of-dilution method originally developed by USDA for use on rice, prunes, corn, potatoes, peas, and other agricultural products.

Knowing the moisture content of the beet pulp helps control the operation of the sugar-beet presses.

The method was originated by H. F. Launer and Y. Tomimatsu of the ARS Western utilization division, Albany, Calif. The 10-minute analysis was applied to sugar-beet pulp by chemists A. E. Goodban, T. Jaouni, and R. M. McCready at Albany.

Addition of concentrated sulfuric acid to the dichromate-treated pulp produces heat and thus facilitates rapid oxidation. Solids content is found by measuring the amount of potassium dichromate consumed in oxidizing the pulp sample. Subtracting the weight of the solids from the total weight of the wet-pulp sample gives the moisture content.

This method is inexpensive and as accurate as the slow oven drying.

Potato flakes go over

Recent improvements in making potatoes flakes make it possible to produce this dehydrated mashed potato product from many varieties grown in different parts of the country (AGR. RES., January 1957, p. 7).

A special, low-temperature precooking step permits the use of many low-solids varieties. USDA researchers also found that cooling potatoes after precooking makes the process even more widely adaptable, enabling production of flakes from potatoes that contain only 17 percent solids. Cooling also results in smaller flakes.

The potato-flake process was developed at the ARS Eastern utilization division, Philadelphia. A total of 6 processors are expected to convert more than 4 million bushels of fall potatoes into flakes. Plants are at Bakersfield, Calif.; Island Falls and Hartland, Maine; Wayland, N. Y.; Idaho Falls, Idaho; and Ontario, Oreg. Others are being built in Idaho, Michigan, and North Dakota. European and Canadian concerns are also considering manufacture, and plants are already going up at Munich, and Gmuend, Austria.

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