

ENGINEERING RESEARCH INSTITUTE
THE UNIVERSITY OF MICHIGAN
ANN ARBOR

Progress Report No. 4

HIGH RADIOPASTEURIZATION OF FOODS
Period March 21 to May 20, 1957

Lloyd E. Brownell
Katherine Kuipers
John V. Nehemias

The University of Michigan

Joan Shaw

Kelvinator Division, American Motors Corporation

Project 2596

QUARTERMASTER FOOD AND CONTAINER INSTITUTE
FOR THE ARMED FORCES, CHICAGO
CONTRACT NO. DA 19-129-QM-756

August 1957

en gn

UMR4646

v. 4

CONTRACT RESEARCH PROGRESS REPORT

QUARTERMASTER FOOD AND CONTAINER INSTITUTE
FOR THE ARMED FORCES, CHICAGO

Research and Development Division
Office of the Quartermaster General

Fission Products Laboratory
The University of Michigan
Engineering Research Institute
Ann Arbor, Michigan

Contract No. DA 19-129-QM-756
File No. S-527
Report No. 4 (Progress)
Period: 21 March 1957 to
20 May 1957
Initiation Date: 21 September 1956

Official Investigator: Lloyd E. Brownell, Supervisor, Fission Products
Laboratory, Professor of Chemical and Nuclear
Engineering, The University of Michigan

Collaborators: Katherine Kuipers, Home Economist, Fission Products Laboratory
Joan Shaw, Home Economist, Kelvinator Division, American
Motors Corporation
John V. Nehemias, Research Associate, Fission Products Labora-
tory

Title of Contract: High Radiopasteurization of Foods

SUMMARY

This is the fourth progress report of research performed at the Fission Products Laboratory of The University of Michigan in the field of high radio-pasteurization of foods and of investigations made with the cooperation of the Kelvinator Institute for Better Living of the Kelvinator Division of American Motors Corporation.

In this report further storage data are reported on Beef Swirls, Barbe-cued Pork Chops, Shrimp Creole, peas, apples, pineapple, and pastry shells. The storage properties of raw pork and a new product, Goulash, are discussed.

THIS IS NOT A FINAL REPORT. CONCLUSIONS STATED ARE SUBJECT TO CHANGE ON THE BASIS OF ADDITIONAL EVIDENCE. THIS INFORMATION IS NOT TO BE REPRINTED OR PUBLISHED WITHOUT WRITTEN PERMISSION FROM HEADQUARTERS, QM R AND D COMMAND, NATICK, MASSACHUSETTS.

FRUITS AND VEGETABLES

APPLES

Of the three varieties of apples under study, Golden Delicious, Delicious, and Northern Spy, the effect of irradiation is most noticeable when comparing irradiated and nonirradiated Golden Delicious Apples. Twenty-three percent of the control apples had spoiled by the end of the seventh month of storage, while only two percent of those apples receiving 25,000 rep had spoiled. Four percent of those apples receiving 50,000 rep and two percent of those receiving 100,000 rep had spoiled. All spoilage could be attributed to brown rot, usually followed by mold (see Fig. 1).

GOLDEN DELICIOUS APPLES SEVEN MONTHS AFTER HARVEST
(Irradiated after harvest without storage prior to irradiation)

Dose (rep)	% of Samples Spoiled	Reason for Spoilage
0	23	Rot
25,000	2	Rot
50,000	4	Rot
100,000	2	Rot

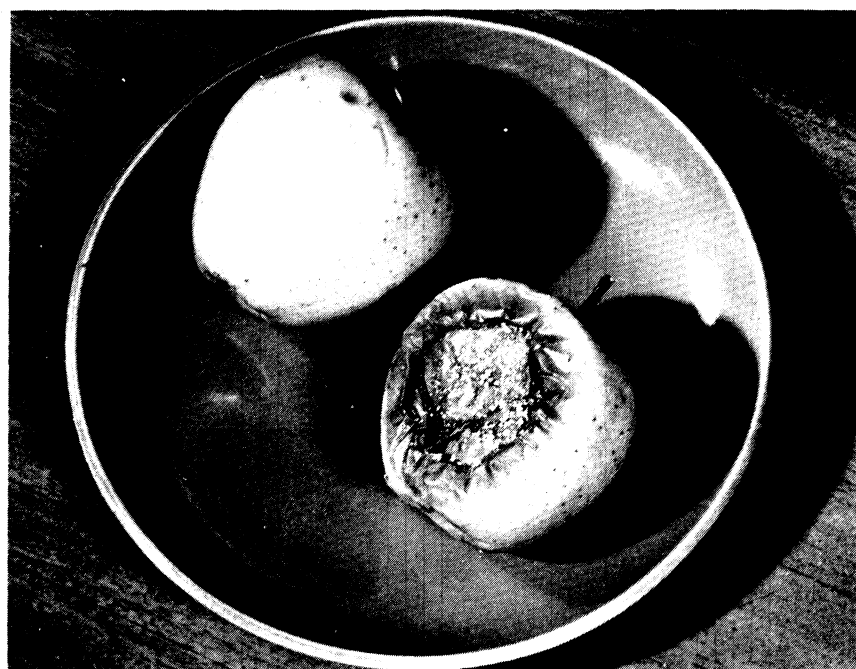


Fig. 1. Golden Delicious Apple irradiated shortly after harvest at 100,000 rep shown with spoiled control apple seven months after harvest.

Only one Delicious Apple has shown signs of deterioration after seven months of storage. This apple had been irradiated at 100,000 rep and was bruised in handling. None of the control apples has deteriorated to this date.

Fifty percent more Northern Spy control apples have spoiled than irradiated apples. However, few samples are involved (a total of eleven apples have spoiled to date). Further storage data will be reported in the next progress report.

PINEAPPLES

The pineapple irradiated at 800,000 and 1,000,000 rep and reported in the last progress report is still not an acceptable product after two months of storage at both levels of irradiation. The flavor has not improved on storage. Both the blanched and unblanched pineapple were described as tasting flat with a sweet-sour flavor and a bitter after-taste. The texture of the unblanched pineapple has degraded until it cannot be distinguished from the blanched product. At no time after irradiation could the blanched or unblanched pineapple be considered an acceptable product.

PEAS

To the end of this reporting period, only ten of the original 100 packages of peas (experiment "A") remain and these cannot be considered to be in good condition. While there is no evidence of mold, the peas appear mushy and have bleached to an ivory green color. No gas is evident in the bags. These peas, as reported in Progress Report No. 3, received one million rep and were packaged in polymylar envelopes. They are four and a half months old at the end of this reporting period. The peas in Pea Experiment "B" were irradiated one week after those in Pea Experiment "A." However, the peas in Experiment "B" are still firm. No samples have been lost and no degrading has been noted except bleaching which has continued to an olive green color. Further changes as they occur will be reported in the next progress report.

RHUBARB

MacDonald Strawberry Rhubarb was purchased from a local farmer, processed, packaged, and placed in the irradiation chamber within five hours of the time it was picked in the field. The rhubarb was cleaned and the stalks cut into inch-long pieces. It was combined with sugar at a ratio of 1-1/4 cups sugar to 8 cups rhubarb. No water was added. The product was cooked until it formed a sauce but many pieces were still intact. Before irradiation the rhubarb sauce was a bright rose color, characteristic of the highest quality of this

variety of rhubarb. The product was packaged in polymylar envelopes and irradiated at a rate of 153,000 rep per hour. After the samples had received approximately 300,000 rep, they were examined for visible changes. The color, it was noted, had changed from bright rose to a muddy brown. At approximately 600,000 rep the samples were again examined. All samples this time were greenish brown. At the end of the total irradiation, 1×10^6 rep, the color of the rhubarb was green with occasional fibers of pink. The color is typical of non-irradiated, cooked rhubarb of another variety that has little red pigment. The consistency of the sauce when compared with the control was more liquid. The sauce was homogeneous; no whole pieces of rhubarb could be found.

The irradiated samples were stored with the control samples at 40°F. The first control sample had spoiled (mold) at 19 days of storage. The last sample spoiled 12 days later. All irradiated samples are still in excellent condition. The flavor is very good and characteristic of freshly cooked rhubarb. Samples examined immediately after irradiation and after several weeks of storage exhibited no off odor. The samples will be examined regularly for degrading of the product as well as for mold and other indications of spoilage.

PRE-COOKED FOODS

BEEF SWIRLS

After 2-1/2 months of storage at 40°F, the Beef Swirls began to show the first signs of deterioration. No mold was found; however, the flavor has gradually changed. This flavor was described as being more salty than formerly. Occasional samples exhibit a more intense flavor than the nonirradiated samples of that batch that have been stored in the frozen state. The total product was still described as "good."

After three months of storage, some samples showed a considerable amount of drip. The product was less firm than formerly. The flavor was still considered "good." The color of the tomato paste in some of the samples had bleached from bright tomato red to orange or a dull pink. Beef Swirls irradiated at a rate of 35,000 rep per hour were compared with those irradiated at 153,000 rep per hour after three months of storage. All samples showed an increase in the amount of drip. When the two groups were compared organoleptically, those samples irradiated at 35,000 rep per hour were judged to have a slightly stronger flavor than any of those samples irradiated at the higher dose rate. No difference in color or odor was detected when comparing the two groups. No irradiated sample had spoiled after three months of storage. All the control samples had developed excessive moisture. A decided spoiled odor was detected in all control samples checked at the end of 16 days of storage at 40°F. All samples of control Beef Swirls were soft and some envelopes were very highly inflated. Although the samples were considered spoiled, those that were not gaseous were observed until the 21st day when all samples exhibited mold. All bags were very inflated. In previous experiments the control samples were considered to be spoiled at ten days. Further changes in the product will be described in the following progress report.

BARBECUED PORK CHOPS

The pork chops reported in the previous progress report have been checked regularly for signs of mold and other indications of deterioration. After 60 days of storage at 40°F, all irradiated samples were still in good condition. The flavor is good, as is the color; however, the texture is somewhat less desirable than it was immediately after irradiation. The product seems more dry. This dryness was first noted after 25 days of storage and was evident even after the pork chop was warmed in the Barbecue Sauce in which it had been stored. This difference is small when considering the total product. Barbecued Pork Chops may still be considered a good product after 60 days of refrigerated storage. All control samples showed excessive moisture and had a decided spoiled odor at 13 days. Continuing observations will be made in the next reporting period and will be reported.

SHRIMP CREOLE

The Shrimp Creole (see Fig. 2) prepared in January of this year has been under refrigerated storage for more than four months. During the storage period, the samples have gradually exhibited an increasing amount of almost clear liquid. However, when the product is heated the liquid is absorbed and again becomes part of the mixture. The flavor of the Creole has gradually become somewhat more bland on storage; however, no off flavors have developed. The grains of rice are still distinct and not soggy after the product has been warmed through, preparatory to eating. The odor is still characteristic of the product.

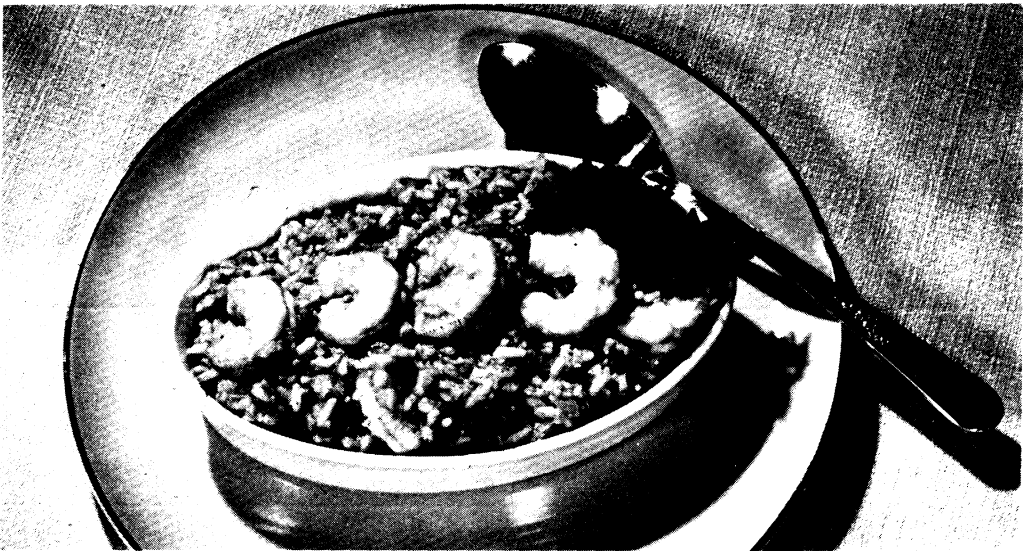


Fig. 2. Shrimp Creole irradiated at 1,000,000 rep and stored at 40°F. Shown after four months of storage.

GOULASH

In conjunction with work on the development of a Beef Stew recipe that will withstand unfavorable radiation flavor change, a recipe for Hungarian Goulash is being developed. The meet used is 1/2 beef, 1/4 pork, and 1/4 veal. Spices are salt, pepper, and paprika. Other ingredients are onions, garlic, tomato juice, and mushrooms. The exact spice level and percent of moisture is yet to be determined. The current product is an excellent meat dish with no "irradiation" flavor at one million rep. The exact recipe will be given in a future report.

RAW PORK CHOPS

Untreated, raw pork chops purchased from the University Food Service were packaged in polymylar envelopes and irradiated at one million rep without further treatment. The pork chops have been stored for two months at 40°F. The color of the pork chops immediately after irradiation was a vibrant pink. The irradiated pork chops have retained this color for two months at 40°F. A slight amount of drip is discernible. When the irradiated pork was compared with the nonirradiated samples immediately after irradiation, the irradiated pork exhibited a fresher appearance. The nonirradiated pork was greyer and darker than the pink irradiated pork. The control samples gradually turned more grey and lost all their pink cast. By the eleventh day, the control pork chops were slimy, showed some mold, and were judged to be spoiled. There has been little discernible change in the irradiated pork chops. Figure 3 shows irradiated and nonirradiated raw pork chops after 60 days of refrigerated storage.

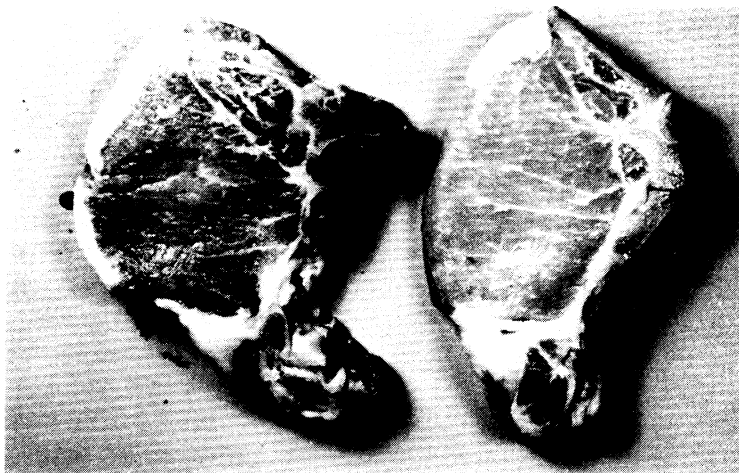


Fig. 3. Nonirradiated pork chop (left) with pork chop irradiated to 1×10^6 rep (right) after storage at 40°F for 60 days.

The flavor of the chop when broiled differs from a nonirradiated chop; however, this difference is not displeasing. The flavor and odor might be described as slightly smoky and rather like fresh ham. After broiling to the "well-done" stage, the center of the pork remained a decided pink color. The outside of the chop browned normally. Further changes during the storage life of this product will be reported in the following progress report.

BAKED GOODS

UNBAKED PASTRY SHELLS

A storage experiment was designed using the fat that gave the most satisfactory pastry in previous experiments (Fluffo). Three cups of sifted pastry flour were combined with one teaspoon salt, one cup plus two tablespoons Fluffo, and nine tablespoons cold water. The ingredients were combined by the standard method. The pastry was rolled out between lightly floured plastic sheets, cut into pieces, packaged in polymylar envelopes, and irradiated at one million rep. These samples were stored with control samples at 40°F.

By the nineteenth day of storage all control samples had spoiled. At the end of this reporting period the irradiated pastry shells are five weeks old and all samples appear in good condition. When baked, the pastry is flaky, crisp, and flavorful. Further storage data will be reported.

UNIVERSITY OF MICHIGAN



3 9015 02539 6931