SENSORY EVALUATION OF FRENCH FRIES FROM ADVANCED SELECTIONS AT NORTH DAKOTA STATE UNIVERSITY

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Potatoes are one of the most efficient and nutritious food crops grown (Adams, 1975). About 16 million tons of potatoes are grown annually in the U.S. with 55 percent of this total consumed in the processed form (Brissman, 1982; Regional Research Project -NC-150, 1983). Because of social changes since World War II, consumers have demanded more convenience, better quality and improved nutrition in their food products. Through development and marketing efforts, many processed foods have been made available to and are conveniently used by the consumer. The consumption of potatoes has shifted from fresh to processed in the past few decades. In recent years, the annual per capita consumption of potatoes has varied as follows:

	1950	1966	1970	1977	1979
Per capita consumption, total (lbs)	102	117	119	122	118
Per capita consumption, fresh (lbs)	90.6	72.1	59.6	54.4	52.6
Per capita consumption, processed (lbs)	1.4	44.9	59.0	67.5	65.5
% of total consumption processed	11.2	38.4	49.4	55.3	55.5

According to North Dakota State University's Food Service, NDSU alone served more than 18 tons of french fries, 25 tons of hash browns, 17 tons of mashed potatoes and 2 tons of potato chips during the 1982-83 academic year.

Continued development of new potato varieties for processing is believed to be the key to the future of the potato industry. In addition to selecting for qualities such as high yield, disease resistance, early maturity, tuber size and shape, it is important that sensory testing be utilized as a valuable tool for assessing new potato selections. The purpose of this study was to evaluate the sensory quality of finished potato products obtained from advanced selections of North Dakota State University breeding lines to assist in determining their future use as potential processing varieties.

Dreher is former assistant professor, Berglund is lecturer and Jahner is graduate student, Department of Food and Nutrition; Johansen is professor and Farnsworth is research technician, Department of Horticulture; Orr is Director, USDA Red River Valley Potato Research Laboratory.

Samples and treatments

Potato selections were developed by the Horticulture Department and grown for three consecutive years on test plots located at Grand Forks. These selections were processed into french fries according to standard methods at the Red River Valley Potato Laboratory in East Grand Forks, MN.

Approximately 5-kilogram samples of raw tubers from each advanced selection being tested were peeled with an abrasive peeler, and peeled tubers were cut into strips with a vegetable cutter. The cut strips were dipped in bisulfite (1%) for 5-10 seconds to retard surface darkening, blanched in water at 68°C for 4 minutes with a screw conveyor, par-fried in vegetable oil (60% cottonseed-40% corn) at 187°C for 130 seconds with a specially designed 15-cm wide cooker (Heat and Control), passed through a 70°C airstream to remove excess oil, screened of small strips and pieces, separated and frozen in a blast freezer at -18°C. The par-fried, frozen potato strips were packaged in fiberboard packages and transferred to North Dakota State University while packed in dry ice. The processed samples were stored in a freezer at the NDSU Food and Nutrition Laboratories and subsequently weighed and coded.

Sample preparation

A previously weighed-out 200-gram sample of french fries was placed into a frying basket and submerged into

hot vegetable oil at 180°C for exactly 90 seconds. The fries were drained for 15 seconds and blotted between two layers of paper towels. Afterward, the fries were sprinkled with 0.75 grams of iodized salt and served to the sensory panelists within three minutes from the time the fries were removed from the oil. Ore-Ida[1] brand (commercially processed Russet Burbank) shoestring potatoes were used as a daily reference and Russet Burbank fries from the test plots were used as a daily check. Tests were conducted three days a week at 11:30 a.m. Eight to nine samples were served each day, including the reference and check.

Sensory evaluation

Sensory quality attributes including color, texture and flavor were measured by six trained panelists using a 9-point hedonic rating scale (1-inedible to 9-excellent) (Amerine et al., 1965; Johnston, 1979). The panel members consisted of faculty, staff and a graduate student. Each sample was served to the panelists in triplicate. The test was performed in partitioned booths with incandescent lighting. Samples were randomly coded and served individually with bottled spring water between samples. Sample sizes consisted of approximately 10 fries.

RESULTS AND DISCUSSION

A potato variety or selection must pass a long series of tests before it is judged ideal for french fry processing. Good sensory quality (consumer acceptance) makes a significant contribution to this process, because if consumers do not like the finished product it will not be eaten. The ultimate goal would be to identify advanced selections scoring high in sensory quality, yield, disease

Table 1. Comparison of french fry sensory scores

Color			Texture			Flavor		
Selection/Variety	Mean S.D.	(*)	Selection/Variety	Mean S.D.	(*)	Selection/Variety	Mean S.D.	(1)
689-3**	8.53 —	(1)	689-3	7.71 —	(1)	689-3	7.77 —	(1)
944-6	8.19 —	(1)	944-6	7.50 —	(1)	671-4 Russ	7.39 —	(1)
651-5	7.93 ± 0.66	(2)	TND22-2	7.48 —	(1)	455-1 Russ	7.37 —	(1)
678-8	7.86 ± 0.76	(2)	651-5	7.29 ± 0.13	(2)	Ore Ida	7.31 ± 0.26	(2)
467-3	7.82 ± 0.45	(2)	119-3	7.19 ± 0.33	(3)	119-3	7.29 ± 0.40	(3)
55-7	7.73 ± 0.21	(2)	612-9	7.16 ± 0.29	(2)	671-2 Russ	6.98 ± 0.43	(2)
445-1	7.62 ± 1.20	(2)	457-17	7.16 ± 0.13	(2)	651-9	6.95 —	(1)
TND22-2	7.49 —	(1)	671-1 Russ	7.13 —	(1)	678-8	6.94 ± 0.72	(2)
457-17	7.47 ± 1.42	(2)	467-3	7.05 ± 0.40	(2)	S-1	6.86 —	(1)
S-1	7.47 —	(1)	651-9	6.98 —	(1)	55-7	6.84 ± 0.10	(2)
Ore Ida	7.44 ± 0.64	(2)	678-8	6.97 ± 0.04	(2)	Crystal	6.83 ± 0.75	(3)
612-9	7.31 ± 1.29	(2)	Ore Ida	6.95 ± 0.18	(2)	TND14-1 Russ	6.81 ± 0.03	(2)
657-2	7.21 ± 0.37	(2)	657-2	6.92 ± 0.52	(2)	612-9	6.79 ± 0.80	(2)
651-9	7.20 —	(1)	TND14-1 Russ	6.90 ± 0.16	(2)	433-5	6.78 —	(1)
Crystal	7.11 ± 0.86	(3)	Crystal	6.87 ± 0.45	(3)	457-17	6.77 ± 0.64	(2)
671-4 Russ	7.03 —	(1)	445-1	6.86 ± 0.45	(2)	467-3	6.62 ± 0.31	(2)
450-11 Russ	7.00 —	(1)	770-4 Russ	6.79 ± 0.07	(2)	843-5 Russ	6.59 —	(1)
455-1 Russ	6.80 —	(1)	Lemhi	6.72 ± 0.04	(2)	657-2	6.54 ± 0.85	(2)
TND14-1 Russ	6.59 ± 0.48	(2)	671-2 Russ	6.77 ± 0.64	(2)	800-4 Russ	6.53 —	(1)
671-2 Russ	6.54 ± 0.47	(2)	843-5 Russ	6.72 —	(1)	966-5 Russ	6.53 —	(1)
433-5	6.53 —	(1)	966-5 Russ	6.64 —	(1)	450-11 Russ	6.50 —	(1)
388-1 Russ	6.24 ± 0.90	(3)	146-4R (Redsen)	6.58 —	(1)	537-8 Russ	6.46 ± 1.00	(3)
537-8 Russ	6.18 ± 1.14	(3)	455-1 Russ	6.50 —	(1)	967-1 Russ	6.41 —	(1)
966-5 Russ	6.18 —	(1)	450-11 Russ	6.50 —	(1)	146-4R (Redsen)	6.39 —	(1)
146-4R (Redsen)	6.14 —	(1)	388-1 Russ	6.48 ± 1.01	(3)	455-1	6.34 ± 0.16	(2)
Lemhi	6.09 ± 1.15	(2)	537-8 Russ	6.38 ± 1.21	(3)	388-1 Russ	6.34 ± 0.31	(3)
800-3 Russ	6.03 —	(1)	799-2 Russ	6.33 —	(1)	770-4 Russ	6.25 —	(1)
770-4 Russ	5.99 ± 0.35	(2)	Kennebec	6.28 —	(1)	Lemhi	6.28 ± 0,86	(2)
967-1 Russ	5.97 —	(1)	971-5 Russ	6.28 —	(1)	651-5	6.06 ± 0.66	(2)
Kennebec	5.61 —	(1)	433-5	6.22 —	(1)	971-5 Russ	5.94 —	(1)
843-5 Russ	5.61 —	(1)	722-2 Russ	6.10 ± 0.47	(3)	534-4 Russ	5.92 —	(1)
Russet Burbank	5.59 ± 0.30	(3)	Russet Burbank	6.08 ± 0.44	(3)	799-2 Russ	5.86 —	(1)
534-4 Russ	5.45 —	(1)	800-4 Russ	6.0 —	(1)	TND 22-2	5.79 —	(1)
971-5 Russ	5.39 —	(1)	S-1	6.00 —	(1)	Kennebec	5.59 —	(1)
799-2 Russ	5.30 ± 0.40	(3)	534-4 Russ	5.94 —	(1)	Russet Burbank	5.57 ± 0.36	(3)
Viking	4.30 ± 0.50	(3)	967-1 Russ	5.61 —	(1)	722-2 Russ	5.55 ± 0.80	(3)
722-2 Russ	4.25 —	(1)	Viking	5.38 ± 0.25	(3)	Viking	4.35 ± 0.29	(3)
800-2 Russ	4.00 —	(1)	800-2 Russ	4.97 —	(1)	800-2 Russ	4.04 —	(1)

*Number of years tested

**All numbered selections are ND numbers except TND14-1 Russ and TND22-2 which are Texas, North Dakota selections. S1 is a commercial check and Ore Ida is a commerically processed Russet Burbank.

[1]Mention of commercially produced potato products is not to be construed as an endorsement of any brand by the USDA or North Dakota State University.

and insect resistance, tuber size and shape, early maturity, and nutritional quality.

The sensory scores for french fries from advanced selections and checks are shown in Table 1. The degree of color variation is shown in Figure 1. The sensory panelists were instructed to rate the lighter colored fries higher than the darker colored fries because the color of the lighter fries can be modified by industrial processing (Figure 1). Several advanced selections exhibited better french fry characteristics than the industrial standard, Russet Burbank. This trend was especially noted for french fry color and texture. In these categories more than 10 selections rated higher than the reference samples. Samples with low sensory scores are generally eliminated from the screening process. Selection ND 689-3 samples had the highest rating in all three sensory attributes, but this selection was eliminated from further testing because it was found to be a virus carrier. This illustrates the importance of wide-range testing for overall potato quality. For those samples with over one year's data, the standard deviation was generally less than ± 1.00, which indicates relative consistency from year to year. The commercially processed Russet Burbank samples consistently scored higher in all sensory attributes than the test plot Russet Burbank samples. This difference is expected and is probably due to special commercial processing techniques that enhance consumer preference independent of variety.

The comparison of sensory scores provided by this screening process has assisted the breeder in selecting material which can meet the present and future demands of the processing industry for quality potato products. The advanced selections with high sensory scores are further evaluated in subsequent years. Several of the advanced selections had sensory scores rated above the Russet Burbank samples and these selections will help maintain the high quality of processed potato products form North Dakota.

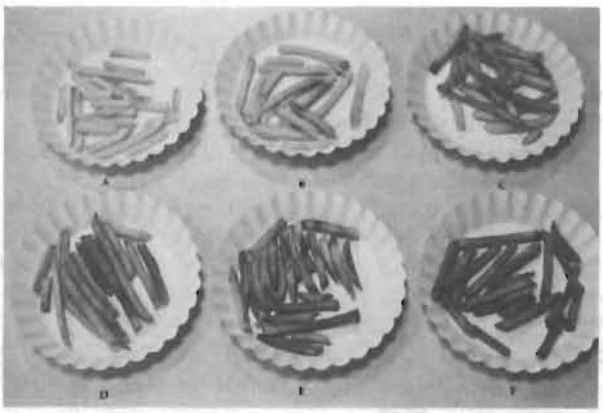

Figure 1. Color Variation of French Fry Selections: A—944-6, B—651-9, C—Russet Burbank, D—770-4 Russ, E—971-5 Russ, F—800-2 Russ.

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