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

Mark Dreher, Robert Johansen, Paul Orr, Bryce Farnsworth, Patricia Berglund and Debra Jahner

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:

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<thead>
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</thead>
<tbody>
<tr>
<td>Per capita consumption, total (lbs)</td>
<td>102</td>
<td>117</td>
<td>119</td>
<td>122</td>
<td>118</td>
</tr>
<tr>
<td>Per capita consumption, fresh (lbs)</td>
<td>90.6</td>
<td>72.1</td>
<td>59.6</td>
<td>54.4</td>
<td>52.6</td>
</tr>
<tr>
<td>Per capita consumption, processed (lbs)</td>
<td>1.4</td>
<td>44.9</td>
<td>59.0</td>
<td>67.5</td>
<td>65.5</td>
</tr>
<tr>
<td>% of total consumption processed</td>
<td>11.2</td>
<td>38.4</td>
<td>49.4</td>
<td>55.3</td>
<td>55.5</td>
</tr>
</tbody>
</table>

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.

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 panels with three minutes from the time the fries were removed from the oil. Ore-Ida 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

<table>
<thead>
<tr>
<th>Selection/ Variety</th>
<th>Color Mean S.D. (*)</th>
<th>Texture Mean S.D. (*)</th>
<th>Flavour Mean S.D. (*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>689-3**</td>
<td>8.53</td>
<td>7.11</td>
<td>8.19</td>
</tr>
<tr>
<td>944-6</td>
<td>8.19 ± 0.48 (2)</td>
<td>7.29 ± 0.13 (2)</td>
<td>7.77 ± 0.04 (2)</td>
</tr>
<tr>
<td>657-5</td>
<td>7.93 ± 0.66 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>457-17</td>
<td>7.49 ± 0.42 (2)</td>
<td>7.13 ± 0.40 (2)</td>
<td>7.47 ± 0.42 (2)</td>
</tr>
<tr>
<td>651-9</td>
<td>7.50 ± 0.27 (2)</td>
<td>6.98 ± 0.04 (2)</td>
<td>7.49 ± 0.47 (2)</td>
</tr>
<tr>
<td>800-2 Russ</td>
<td>4.00 ± 0.72 (2)</td>
<td>6.94 ± 0.04 (2)</td>
<td>7.71 ± 0.13 (2)</td>
</tr>
<tr>
<td>TND22-2</td>
<td>7.39 ± 0.48 (2)</td>
<td>6.94 ± 0.04 (2)</td>
<td>7.49 ± 0.47 (2)</td>
</tr>
<tr>
<td>TND14-1 Russ</td>
<td>6.52 ± 0.85 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>966-5 Russ</td>
<td>6.18 ± 0.63 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>388-1 Russ</td>
<td>6.49 ± 0.40 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>450-11 Russ</td>
<td>6.77 ± 0.16 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>456-1 Russ</td>
<td>6.53 ± 0.35 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>433-5</td>
<td>6.52 ± 0.35 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
<tr>
<td>966-5 Russ</td>
<td>6.00 ± 0.42 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
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<td>433-5</td>
<td>6.52 ± 0.35 (2)</td>
<td>7.19 ± 0.33 (3)</td>
<td>7.11 ± 0.86 (3)</td>
</tr>
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</table>

*Number of years test
**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 commercially processed Russet Burbank.

1Mention 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 maturi-
ty, and nutritional quality.

The sensory scores for french fries from advanced
selections and checks are shown in Table I. 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 fur-
ther 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 Bur-
bank 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 ad-
vanced 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.

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