ISSN 0097-0905

Quality of Tomato Paste, Sauce, Puree, and Catsup

By Lester Hankin

A cooperative study by The Connecticut Agricultural Experiment Station, New Haven and the Food Division of the Connecticut Department of Consumer Protection, Hartford.

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION
New Haven Bulletin 828 January 1986

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Tomatoes are believed to have originated in tropical America and were taken from Mexico or Peru during the 16th Century to Europe where they were called "golden" or "love apples" and grown as a curiosity. During the early 1800s, tomatoes were cultivated for market in Europe, but considerable time passed before they were universally accepted as food. Although Thomas Jefferson cultivated tomatoes in 1781, they did not become popular as a vegetable in America until about 1840. Canning of tomatoes was first recorded in 1847 in Pennsylvania. (2)

Annually Americans use more than 23 pounds of processed tomatoes (exclusive of catsup and sauce) compared with 35 pounds of all other processed vegetables (2). In dollar value, tomatoes are second to potatoes among all vegetables produced (2). The retail value of tomato paste and sauce is $422 million; if spaghetti sauce is included, the total value is $1.2 billion (4).

Section 155.191 of the Code of Federal Regulations (CFR) (1) defines standards for tomato concentrates. Tomato concentrates are prepared by concentrating one more of the following: (i) Liquid from mature tomatoes of the red or reddish varieties (Lycopersicum escelentum P. Mill.). (ii) Liquid from the residue from preparing tomatoes for canning, consisting of peelings and cores, with or without tomatoes or pieces. (iii) Liquid from the residue from partial extraction of juice from tomatoes. Optional ingredients may include salt, lemon juice or organic acids, sodium bicarbonate, water, spices and flavorings.

Tomato puree or tomato pulp must contain at least 8 percent but less than 24 percent tomato solids. Tomato paste must contain at least 24 percent tomato solids. Although tomato catsup, defined in CFR section 155.194 (1), is made from any combination of tomato ingredients it may also contain optional ingredients, including spices and sweeteners. We have used the spelling "catsup", but ketchup and catchup are equally acceptable. There are no regulations for tomato sauce.

Fifty-nine samples of tomato products (16 pastes, 19 sauces, 9 purees, and 15 catsups) were collected by inspectors of the Connecticut Department of Consumer Protection at retail stores and examined at The Connecticut Agricultural Experiment Station for compliance with regulations and for nutrients.

METHODS

Analyses were according to Official AOAC Methods (3) or methods defined in CFR 155.3 (1). Glucose and fructose were determined by gas chromatography using a method devised by V. Agarwal in this laboratory (unpublished). The percentage of total carbohydrate and calories were calculated. Calories are the % fat X 8.79 + [(% total solids - (% fat + % ash))] X 4. Total carbohydrate is % total solids - (% fat + % protein + % ash). Fiber was measured as crude fiber, essentially non-nutritive material.

RESULTS AND DISCUSSION

The moisture, solids, fiber, salt, sodium, total carbohydrate, glucose, fructose, protein, fat, and calories are shown for each of the 59 samples by brand name in Table 1. As expected, both fat and protein content were low because tomatoes are not a rich source of these nutrients. All samples contained the amount of product claimed on the label. The percentages of the container filled by each type

Table 1. Analysis of Tomato Paste, Sauce, Puree, and Catsup.

Sample No.	Brand	Moisture,%	Solids,%(a)	Fiber,%	Salt,%	Sodium, mg/100g	Total Carbohydrates,%	Glucose,%	Fructose,%	Protein,%	Fat,%	Calories per 100g
PASTE												
1	Contadina, no salt added	73.5	26.8	2.1	0.37	165	18.4	5.5	5.2	3.4	0.4	90
2	Contadina, no salt added	73.6	25.0	2.0	0.34	125	18.2	5.7	6.5	3.6	0.3	90
3	Finast/Edwards	75.1	24.0	1.8	0.31	170	18.0	6.2	6.5	3.0	0.3	86
4	Food Club	74.0	25.2	2.8	0.38	19	19.8	6.2	7.9	3.3	0.4	96
5	Grand Union	75.1	24.0	1.8	0.31	78	19.2	6.1	7.2	3.1	0.4	93
6	Hunts, no salt added	73.8	25.4	2.0	0.37	50	20.1	4.3	4.9	3.1	0.5	97
7	Hunts	72.7	26.6	2.8	0.76	295	20.4	5.7	7.4	3.6	0.4	100
8	Krasdale	74.9	24.6	3.1	0.34	67	19.3	6.2	7.3	3.3	0.4	94
9	Luigi Vitelli, prod. of Italy	73.8	25.7	1.8	0.45	80	16.9	4.4	6.4	4.4	0.3	88
10	Pathmark	73.5	25.3	2.0	0.33	140	19.1	5.4	7.7	3.0	0.3	91
11	Pope, imported from Portugal	75.2	24.4	2.7	0.46	70	18.8	6.7	7.0	3.3	0.4	96
12	Pope, imported from Italy	72.2	28.6	2.0	0.59	145	20.2	6.6	7.9	4.4	0.3	101
13	Redpack	74.1	24.5	1.7	0.41	150	18.2	5.6	7.3	3.3	0.2	88
14	Rienza, imported from Italy	76.0	24.2	2.2	0.60	115	15.5	4.0	5.0	3.5	0.3	79
15	Rosa, imported from Italy	73.8	25.6	1.8	0.45	80	16.9	4.4	6.4	4.4	0.3	88
16	Shurfine	75.0	24.7	1.6	0.34	140	17.8	5.4	6.8	3.4	0.3	87
SAUCE												
17	Contadina	90.4	9.0	1.0	1.24	485	5.5	1.7	1.5	1.2	0.2	28
18	Contadina, Italian style	90.4	8.1	0.7	1.28	450	5.7	2.0	2.1	1.1	0.2	29
19	Del Monte	90.1	8.5	0.8	1.50	453	5.7	2.1	2.0	1.2	0.1	29
20	Economy	90.8	9.1	0.6	1.39	450	5.3	1.7	1.6	1.3	0.1	27
21	Finast/Edwards	90.1	9.9	0.7	1.50	640	6.2	1.9	1.4	0.8	0.1	29
22	Food Club	90.7	8.6	0.8	1.07	415	5.0	1.7	1.0	1.7	0.2	28
23	Guaranteed Value	91.1	7.9	0.7	0.73	235	6.4	1.9	1.2	0.5	0.2	29
24	Goya, Spanish style	88.5	10.4	0.7	1.14	540	7.1	1.8	1.2	0.7	0.1	37
25	Grand Union, Spanish style	90.2	9.1	0.7	1.44	640	5.3	2.0	2.8	1.7	0.2	29
26	Hunts, no salt added	90.1	9.5	1.3	0.20	19	6.1	2.7	2.1	1.5	0.2	32
27	Hy-Top	90.8	8.3	1.2	1.38	450	4.7	1.9	1.8	1.3	0.1	25
28	Iberia, Spanish style	89.6	10.2	0.6	1.48	518	6.9	0.8	1.1	0.9	0.1	32
29	Krasdale, Spanish style	90.5	8.7	0.8	1.23	483	5.0	1.6	1.3	1.8	0.2	29
30	Libby's	89.9	9.2	0.6	0.96	315	6.4	2.4	3.1	1.4	0.2	33
31	Pathmark, no salt added	89.3	10.7	0.7	0.19	5	7.6	2.8	2.3	1.4	0.2	38
32	Pathmark	89.2	9.5	0.8	1.33	445	6.3	2.0	1.6	1.6	0.2	33
33	Progresso	89.8	9.6	0.7	1.00	390	6.0	2.0	1.4	1.7	0.2	32
34	Stop & Shop	88.9	9.6	0.7	1.46	430	6.6	2.3	2.3	1.6	0.2	34
35	Shurfine	90.5	9.1	0.6	1.51	543	5.3	1.9	2.0	1.5	0.2	33
PUREE												
36	Finast/Edwards	88.8	12.1	0.9	0.24	67	6.3	2.7	3.1	2.7	0.2	40
37	Grand Union	85.8	13.6	1.1	0.26	85	9.8	3.3	3.8	1.7	0.2	48
38	Hy-Top	90.7	9.6	0.7	0.15	65	6.3	1.9	2.3	1.3	0.2	32
39	Krasdale	85.4	14.3	1.0	0.23	98	10.0	3.4	3.7	2.0	0.2	50
40	Pathmark	89.4	10.6	0.9	0.15	95	7.7	2.5	2.5	1.1	0.2	37
41	Progresso	86.6	13.8	0.9	0.23	70	8.5	3.5	4.1	2.5	0.3	46
42	Redpack	88.3	11.8	1.2	0.21	120	7.9	2.7	3.3	1.4	0.2	39
43	Shurfine	86.7	11.4	0.9	0.18	62	6.5	2.3	2.3	2.4	0.2	35
44	Sweet Life	84.9	14.6	1.3	0.24	50	10.0	3.4	5.6	2.0	0.4	51
CATSUP												
45	Del Monte	65.1	34.9	0.7	2.98	1330	29.6	8.0	3.6	1.9	0.4	128
46	Farm Product, no salt added	71.1	28.9	1.2	0.21	145	23.7	4.7	3.3	3.3	0.3	110
47	Finast	65.4	33.6	0.9	3.26	1290	27.5	9.0	3.5	1.7	0.5	125
48	Food Club	65.4	34.6	1.0	3.08	1100	28.7	4.9	2.7	1.6	0.4	125
49	Guaranteed Value	72.8	27.1	0.7	3.28	1340	21.6	5.5	1.0	1.3	0.4	200
50	Generic, Federated Foods	70.2	29.8	0.7	3.37	1400	24.5	5.7	1.6	1.5	0.3	107
51	Generic, Waldbaums Valu Time	67.3	32.7	0.7	3.50	1280	27.3	8.7	2.9	1.1	0.3	116
52	Grand Union	64.9	35.1	0.8	2.93	1060	30.8	8.8	3.1	1.7	0.3	133
53	Hain, natural imitation	69.1	30.9	1.0	3.54	1345	23.8	7.2	8.2	2.1	0.5	108
54	Heinz	66.7	33.4	1.1	3.21	1205	27.6	8.9	5.0	1.4	0.4	119
55	Hunts, no salt added	64.7	35.3	1.2	0.18	235	32.5	10.9	7.5	1.6	0.3	139
56	Hy-Top	66.5	33.5	0.9	2.99	1330	27.4	8.0	3.6	1.9	0.4	121
57	Krasdale	62.8	37.2	0.7	2.91	1153	31.3	8.0	2.2	1.8	0.4	136
58	No Frills	69.9	30.1	0.9	3.46	1400	24.0	6.9	2.0	1.6	0.4	106
59	Pathmark	66.9	33.1	0.9	3.20	1205	27.1	7.6	4.2	1.7	0.4	119

(a) For paste, sauce and puree, solids designates natural tomato soluble solids. For catsup, solids designates total solids.

Table 2. Average Filling of Containers of Tomato Products.

Product	Avg. % Filling of container	Range
Paste	101	97-105
Sauce	101	97-104
Puree	102	100-105
Catsup	102	100-109

of product are shown in Table 2.

Pastes: All tomato pastes contained more than 24 percent tomato solids as required by Federal Regulations. The range was 24 to 28.6 percent; the average 25.3 percent (Tables 1 and 3). Fiber averaged 2.1 percent. Salt in the pastes, including three labeled "no salt added" (Samples 1, 2, and 6), averaged 0.43 percent. Although samples with labels claiming "no salt added" averaged 0.36 percent, some samples with labels making no claim about salt were slightly lower in salt. (Table 1)

The sodium content averaged 99.6 milligrams per 100 grams; the range was from 19 to 2395 (Table 3). The lower values were for those claiming no salt added. Carbohydrates averaged about 17 percent. Only 13 percent of the carbohydrate content was accounted for by glucose and fructose. The remainder is probably some sucrose and higher polysaccharides as starch, all naturally occurring in tomatoes. Calories per 100 grams averaged 86.5.

Sauces: Percentages for sauces were generally lower than in pastes because sauces contain about 90 percent water as compared with 74 percent in pastes (Tables 1 and 3). Sauces usually contained more optional ingredients to enhance flavor and averaged 1.2 percent salt (Table 3) and about twice the sodium of pastes. The sauce claiming "no salt added" (sample 31) contained about 0.2 percent salt. No Federal Regulations pertain to sauces.

Puree: The purees contained about 3 percent more water than the sauces (Table 3). All purees contained the required minimum 8 percent tomato solids and averaged 12.4 percent, about half the maximum allowed. The salt content was about half that found in pastes (Tables 1 and 3). Most percentages for purees were lower than for pastes because of the higher water content of purees.

Catsups: Catsup is made from a variety of tomato concentrates including liquid, peelings, and cores. Although a wide variety of optional ingredients are used as flavoring, regulations require these to be listed on the label.

Catsups were the thickest product tested, averaging only 67 percent water and fully 33 percent total solids (Tables 1 and 3). They also averaged 2.8 percent salt, more than any other product tested (Table 3). The two samples claiming "no salt added" (Samples 46 and 55) averaged only 0.2 percent salt. Because the salt content was high sodium content was also high, averaging 1121 milligrams per 100 grams, over twice the average of sauces. Calories per 100 grams averaged 126, higher than all other products. The primary reason is the higher carbohydrate content and the lower water content of catsup. Carbohydrates averaged 27.2 percent, about 35 percent more than in pastes and 77 percent more than in sauce (Table 3).

SUMMARY

The fifty-nine tomato products—pastes, purees, sauces and catsups—collected at retail stores in

Table 3. Averages and Ranges of Constituents of Tomato Products.

Product	No. Tested	Solids,%(a)	Salt,%(c)	Total Carbohydrates,%	Fat,%	Protein,%	Calories per 100g
Paste	16	25.3 (24.0-28.6)(b)	0.43 (0.31-0.60)	17.7 (15.5-20.2)	0.34 (0.2-0.5)	3.5 (3.0-4.4)	87 (79-101)
Sauce	19	9.2 (8.1-10.7)	1.20 (0.2-1.5)	6.0 (4.7-7.6)	0.17 (0.1-0.2)	1.3 (0.5-1.8)	31 (27-38)
Puree	9	12.4 (9.6-14.6)	0.21 (0.15-0.26)	8.1 (6.3-10.0)	0.23 (0.2-0.4)	1.9 (1.1-2.7)	42 (32-51)
Catsup	15	32.7 (27.1-37.2)	2.80 (0.2-3.5)	27.2 (21.6-31.3)	0.38 (0.3-0.5)	1.7 (1.4-3.3)	126 (106-200)

(a) For paste, sauce, and puree. solids designates percent natural tomato soluble solids. For catsup, solids designates total solids.
(b) Values for salt include those claiming no salt added.
(c) Salt values include those claiming no salt added.

Connecticut met specifications defined in the Code of Federal Regulations. Pastes contained the most tomato solids, 25 percent; sauces contained the least, 9 percent. The average salt content varied among products from a low of 0.2 percent for purees to 2.8 percent in catsups. Products claiming "no salt added" had less than 0.4 percent salt. Fat and protein were low in all products. Catsups contained the most carbohydrates, averaging 27.2 percent. The carbohydrate content of pastes averaged 17.7 percent, sauces 6 percent and purees 8 percent. Analytical values for all products are given by brand name.

ACKNOWLEDGEMENTS

Analyses were carried out by V. Agarwal, J. Hayes, M. Illig, H. Kocaba, S. McLean and M. Pyles. Samples were collected by D. Pignataro and E. Ronan of the Food Division of the Connecticut Department of Consumer Protection.

REFERENCES

1. Code of Federal Regulations: Title 21, parts 100 to 169 revised to April 1, 1985. U.S. Government Printing Office, Washington, DC.
2. Gould, W. A. 1983. Tomato Production, Processing and Quality Evaluation, second edition. AVI Publishing Co., Westport, CT.
3. Official Methods of Analysis. 1980. 13th edition W. Horwitz, ed. Association of Official Analytical Chemists, Washington, DC.
4. Sacharow, S. 1985. Spaghetti and Tomato Sauces: Why Not Aseptics?. Prepared Foods 154:33-34.