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The Influence of Different Tomato Varieties on Acidity as It Relates to Home Canning

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Abstract: Tomatoes are a popular vegetable for home canning. USDA Guidelines recommend lemon juice or citric acid be added to home-canned tomatoes to increase acidity. In 2007 and 2008, we grew and tested the pH of 15 tomato varieties. Three of the heirloom varieties had statistically lower acidity than the hybrid used as a standard for comparison. Canning tomatoes generally involves using different tomato varieties at various stages of ripening. Although some control of acidity can be exercised by variety selection, Extension agents should encourage those involved in home canning to follow USDA guidelines regardless of the tomato varieties used.

Introduction

The canning of home grown produce has been popular for many years. Tomatoes are the most widely canned product in the United States and also one of the most commonly spoiled products. It is generally accepted that "low acid" products, such as green beans, for example, should be processed in a pressure canner to insure safety from micro-organisms. Other produce, such as peaches and tomatoes, are considered "high acid" and need only be processed in a water bath canner. Tomatoes are considered high acid as long as the pH is below 4.6.

There has been speculation that certain growing conditions and possibly varieties may cause tomato products to have lower acidity than is safe for canning. When this happens, the product must be canned in a pressure canner, as low acid products, or acidified to a pH of 4.6 or lower with lemon juice or citric acid (Kendall, 2006). In a study of 162 home canned tomato products collected in Washington, 6% of the samples collected had a pH value over 4.6, and 3% of those showed visible mold growth (Drake & Price, 1981). Mold growth lowers acidity, allowing botulism to grow which produces a deadly toxin.

Because home growers in general do not know the specific pH of the tomatoes they are growing, it is recommended that they add an acidifying agent such as vinegar, lemon juice, or ascorbic acid to increase the acidity. Acidification guidelines given by the USDA (Complete Guide to Home Canning, 1994), reference the use of bottled lemon juice or citric acid to ensure safe acidity in whole, crushed, or juiced tomatoes. A

survey conducted by Oregon State University Extension (Raab, 1990) showed that 26% of participants did not add any citric acid or lemon juice as instructed to acidify their tomato products. This particular survey shows that one fourth of those surveyed were either skeptical that acidification wasn't needed or were reluctant to add it.

Cooperative Extension Services receive numerous questions each year regarding how to safely can tomatoes and other produce. They have been including in their recommendations for many years that tomatoes selected for canning should not be overripe, bruised, or damaged. Caution has also been given not to use tomatoes from vines damaged by frost, insects, or blossom end rot (Kendall, 2006). Anything that can affect fruit quality or the plant's ability to allow tomatoes to ripen properly may lower acidity. An aspect that has not been well documented is the influence of different tomato varieties on acidity. For example, is a Celebrity tomato less acidic than an older heirloom variety such as Brandywine? Some gardeners have expressed the feeling that older varieties are, in general, more acidic than newer varieties.

In a bulletin from the North Dakota Extension Service regarding the use of lemon juice in canned tomatoes and salsa (Garden-Robinson, Houge, & Smith, 2004), the pH of 15 different tomato varieties were tested. The pH readings were taken from the pure tomato pulp prior to canning and again after lemon juice was added and the tomatoes were made into salsa. In this particular study, all of the raw tomatoes tested had a pH from 4.8 to 5.2 prior to canning. In other words, the acidity was so low that all required that lemon juice be added before they could be processed safely. Lemon juice increased acidity in all samples enough to allow processing without using a pressure canner.

In 2007, we grew and tested the pH of five different tomato varieties (Table 1). We collected enough tomatoes to process all of one variety in each jar. We took a second jar and added lemon juice as per USDA instructions. In each case the pH was lowered by adding lemon juice. The average pH change due to lemon juice being added was .35 over the five varieties. This is consistent with the North Dakota study.

Table 1.
Tomato Acidity Chart â 2007

Variety	Tomato pH	pH of Tomato + Lemon
Celebrity	3.70	3.30
Columbian	3.92	3.54
Jet Star	4.07	3.82
Mountain Fresh	4.00	3.66
Row Pack	3.99	3.59

Methods

In 2008, we conducted an additional study to determine the acidity of different tomato varieties without the use of lemon juice. Tomato varieties selected for the study included Row Pack, Celebrity, Rutgers, Ace, San Marzano, Box Car Willie, Brandywine, Goliath, Legend, Roma, and an unknown variety from a local grocery store. We included in our selection hybrids, heirlooms, and open pollinated varieties. Celebrity is a popular variety among home growers and was our choice to represent the hybrid category when it comes to

comparing pH.

When harvested, tomatoes were sorted into "under ripe," "ripe," and "over ripe" categories, based on their appearance. Under ripe tomatoes were harvested mostly red while a slight green color remained. Ripe tomatoes were firm, with no green color present. The over ripe tomatoes were allowed to sit for a couple days after reaching the ripe stage. We did this with the understanding that stage of ripening may affect tomato pH as well as variety. Some varieties had few fruit ripening at the same time so we did not have many tomatoes to place into all categories.

All samples were analyzed with an Omega hand-held pH tester model 5012. The meter was calibrated using a buffer solution prior to use (each time). Juice was extracted from each tomato and tested separately. The meter was inserted into the juice and then stirred gently before taking a reading (Table 2).

Table 2.
Tomato Acidity Chart â 2008

Variety	Under Ripe	Ripe	Over Ripe
	pH	pH	pH
Celebrity	3.83	3.92	4.03
Row Pack	3.92	4.03	4.22
Rutgers	3.98	4.1	4.06
Ace	4.22	4.32	N/A
Box Car Willie	3.95	4.07	4.13
Each value represents the average pH of three tomatoes.			

Results

The statistical analysis program known as "SAS" was used to compare the pH of different tomato varieties. From the 10 varieties grown, enough data was collected to run comparative statistics on five of them. The three heirloom varieties, "Ace," "Box Car Willie," and "Rutgers," were compared to the hybrid variety "Celebrity." The pH of the heirloom varieties was different from that of the hybrid variety at the 95% confidential level. So within the varieties that we chose, the heirloom tomatoes had a higher pH (so they were less acidic) than the hybrid variety. The open pollinated variety "Row Pack" was not significantly different from either the heirloom or hybrid varieties.

When the pH of the different varieties was compared, on the basis of maturity, we did not see any differences. Although slight differences were observed, in the color of the fruit as well as the pH readings, they did not prove to be significantly different.

Table 3.
Tomato Acidity by Category

Hybrid		Open Pollinated		Heirloom	
Type	Avg. Ripe pH	Type	Avg. Ripe pH	Type	Avg. Ripe pH
Celebrity	3.92	Row Pack	4.03	Rutgers	4.10
				Ace	4.32
				Box Car Willie	4.07
Average	3.92	Average	4.03	Average	4.16

Conclusion

In theory, it is safe to use a water bath canner without adding acidifying agents as long as the pH is less than 4.6. In our study, all varieties had an acceptable pH for canning (3.92-4.36) prior to adding and acidifying agents. Statistically the heirloom varieties had less acidity than the hybrid variety Celebrity. So, in our study the notion that "heirlooms" are more acid than "hybrids" did not hold true.

However, in application, a person is not likely to know the exact pH of each tomato being canned. Nor is it practical to test each jar before it is processed. Home canning often consists of harvesting more than one tomato variety from the garden and processing them together, sometimes adding a mixture of other items such as peppers, spices, etc. Based on this and our findings, we suggest that the USDA recommendations be followed, that all tomatoes and tomato products be properly acidified prior to canning, regardless of the varieties used. We also feel that, although differences in pH due to variety may exist, the study reported here should not be relied upon as the factor to determine whether to add an acidifying agent or not.

Extension agents are educators by profession. Their mission is to teach "research based" methods to the public. For various reasons, rumors or opinions are spread around as though they are truth, such as the notion that "older tomato varieties are more acidic than newer hybrids" and therefore safe to can without acidifying agents. In our study, the tendency was for the older varieties to be less acidic than the hybrid we compared them to. Advice is sought from Extension agents each season regarding which tomato varieties to grow successfully and how to safely process them. We feel that it is important for Extension agents to promote the current USDA recommendations and to understand them well enough to advise others. Using correct methods to process tomatoes for home storage will ensure a safe product. Selecting which tomato variety is used may help control acidity, but it is hard to know how much other local factors such as weather and soil conditions may contribute.

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