

The Origin of Alcohol “Proof”

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Question

What is the origin of the “proof” system for measuring the ethanol content of alcoholic beverages?

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Answer

The use of the term “proof” in connection with the alcohol content of liquors dates back to 16th-century England. When used in this context, the word refers to “a test, trial or demonstration.” This same usage is found in the well-known maxim “The proof of the pudding is in the eating,” meaning that the test of whether the pudding is a success is in the eating. The proof system is based on the selection of an arbitrary standard (called 100 proof) typical of the alcohol content of distilled liquors and the rating of the alcohol content of other beverages in terms of how much larger or smaller they are relative to this standard (1).

The proof system was originally established for purposes of taxing liquors according to their alcohol content and varies from country to country. In 16th-century England, the original test involved soaking a pellet of gunpowder with the liquor. If it was still possible to ignite the wet gunpowder, the alcohol content of the liquor was rated above proof and it was taxed at a higher rate, and vice versa if the powder failed to ignite. By the end of the 17th century, England had introduced specific gravity as the criterion for measuring proof or alcohol content. Since this was highly sensitive to temperature, it resulted in numerous problems with standardization. Not until 1816 was the primary standard precisely defined as 12/13th the specific gravity of pure distilled water at the same temperature.

The United States was luckier. Its proof system was established around 1848 and was based directly on percent alcohol by volume rather than specific gravity, with 50% alcohol by volume being taken as typical of strong distilled liquors and as the 100 proof standard. The most scientific scale, however, was that used in



Figure 1. Joseph-Louis Gay-Lussac (1778-1850).

France, which was established in 1824 by the famous French chemist, Joseph-Louis Gay-Lussac (figure 1), which took 100% alcohol by volume as 100 proof and 100% water by volume as 0 proof. Thus 100 proof on the American scale is 50 proof on the French scale and about 87.6 proof on the British scale. All in all it is a good example of what happens when standards are set by politicians instead of scientists.

Literature Cited

1. H. A. Klein, *The World of Measurements: Masterpieces, Mysteries and Muddles of Metrology*, Simon and Schuster: New York, NY, 1974, pp. 561-575. This volume has been reprinted as a paperback by Dover Books in 1988 under the title, *The Science of Measurement: A Historical Survey*, and is an absolute must for any chemistry teacher interested in the history of units and measurement.

Do you have a question about the historical origins of a symbol, name, concept or experimental procedure used in your teaching? Address them to Dr. William B. Jensen, Oesper Collections in the History of Chemistry, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221-0172 or e-mail them to jensenwb@ucmail.uc.edu

2010 Update

Recently it has come to my attention that many internet sites claim that the gunpowder test dates from the 18th century rather than the 16th century, as suggested by Klein. Regrettably none of these sources, including Klein, provide references that would allow one to double check their claims. However, given the crudity of the gunpowder test and the fact that specific gravity was already suggested as a guide in the 17th century and made official in the 18th century, the claim that the test dates from the 16th century seems the more probably of the two.

Some speculations as to the underlying chemical and physical basis of the gunpowder test have also come to my attention - namely that it ultimately relies

on the fact that potassium nitrate is highly soluble in water but only moderately soluble in ethanol. Thus the greater the water content of the alcohol, the more potassium nitrate it leeches out of the gunpowder and the more likely it becomes that the gunpowder will fail to ignite. By its very nature such a test would lack reproducibility since the size and compactness of the gunpowder grains, the quantity of liquor used to soak the grains, and the time of contact before attempting to ignite the powder would all play a role in determining how much potassium nitrate was dissolved and hence whether or not the gunpowder would ignite.

I have also recently discovered that a separate proof scale was used to rate the strength of vinegar for taxation purposes in early 19th-century England. As with alcohol, specific gravity was used to measure the proof or strength of the vinegar and just as the modified hydrometer used to measure alcohol proof was called an alcoholmeter, so the modified hydrometer used to measure vinegar proof was called an acetometer. For details see:

C. A. Mitchell, *Vinegar: Its Manufacture and Examination*, 2nd ed., Griffin: London, 1926, Chapter 1.