Wood's H:C Ratio

To choose an appropriate hydrogen-carbon ratio for wood considered as an energy source, one must first recognize that wood is made of cellulose and lignin. The mix varies among woods but in bounds. Most wood is cellulose.

Cellulose is a carbo-HYDRATE. Carbohydrates can be represented as CH_2O or H-C-OH. By simple heating, the weak bond of H<>OH breaks, reforming water. The key is that: cellulose + O_2 > CO_2 + water initially present as H_2O or H—HO. There is no O_2 + $2H_2$ process. This view is supported intuitively by the fact that if you heat cellulose "H_2O" leaves as H_2O and what remains is charcoal, ± pure carbon, which approaches a zero H:C ratio.

So, the H:C ratio for wood depends on lignin, which has a complex +/- benzenic structure. As a frame of reference we take woods as 80% cellulose and 20% lignin (means of means).

Observing the rough formulas of lignin [e.g., C(10)H(13)O(4)], we must take away the H_2O also from it. This leaves an H:C ratio about 0.5.

Combining the pure carbon of cellulose and the 0.5 ratio of lignin, wood with 20% lignin effectively has an H:C ratio of 0.1.

Of course, telling what actually burns is hard. The heat of combustion from burning a complex molecule comes from all its component atoms. But because of energetic links inside the molecules, attributing, in terms of shares, the heat of combustion to each component is difficult. And, we can visualize HCOH as H_2-CO or H_2O-C.

Chlorophyll basically decomposes water into H_2 and ½ O_2. H_2 is used to reduce CO_2 to formaldehyde. The pundits of photosynthesis might be able to use isotopes to trace the reactions exactly. This would be fun, but is probably splitting hairs.

Alternatively, corroboration might come from the energy balance of charcoal production. Charcoal was (is) used because it is much lighter than wood, while retaining most of the heat value. It has the minimum of imbibed H_2O, within the molecules or on the loose, so to speak.

The basic point is the 0.1 ratio is conceptually right, and does not claim excessive precision.

J. Ausubel and C. Marchetti, 1998