The Saponification Number of Coconut Oil Fatty Acids

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In the analysis of a mixture of oils or fatty acids, the saponification number is of utmost importance as an index to the presence and probable amount of the coconut oil group of vegetable fats. The determination of other characteristics, such as iodine number and titer, may be necessary to establish the nature of the other fats, but saponification number, which is practically unaffected by hydrogenation, is usually relied upon in the calculation by interpolation of the proportion of coconut oil present.

To make this calculation, in addition to the saponification number of the mixture under examination, one requires an accurate and typical figure for coconut oil or coconut oil fatty acids and an approximate accepted average saponification number for the other likely glycerides or fatty acids present. With the exception of tallow, palm oil, grease, cottonseed oil and butter fatty acids, whose saponification numbers lie above 200, and castor oil and rape or mustard oil group fatty acids, whose saponification numbers lie well below that figure, 200 may be taken as a fairly accurate and typical saponification number for the fatty acids of most of the common oils and fats except those of the coconut oil group.

The selection of a typical saponification number for coconut oil fatty acids at first thought would appear simple. That this is no easy task will be evident after perusal of the following references:

Reference	Glycerides Sap. No.	Mixed Fatty Acids Neut. No. or Sap. No.
Chemical Technology and Analysis of Oils, Fats and Waxes. Lewkowitsch, 6th Ed., Vol. 1, p. 530		271.6 271.5
Ibid. Vol. 2, p. 657	255-260	
Ibid. Vol. 2, p. 659		258
Van Nostrand's Chemical Annual, Olsen., 6th Issue, 1926, p. 122	246-268	
Ibid., p. 126		258-273
Handbook of Chemistry and Physics. Hodgman, 17th Ed., 1932, p. 593	253.4-262	
Ibid., p. 595		258
Technical Methods of Analysis. Griffin, 2nd Ed., 1927, p. 300	246.2-268	
Ibid., p. 301		258
Standard Methods of Chemical Analysis. Scott, 3rd Ed., 1922, Vol. 2, p. 1148	225-268	
Oils, Fats and Waxes. Fryer and Weston, 3rd Ed., 1920, Vol. 1, p. 159	257 (255-260)	
Ibid. Chart bet. pp. 84-85	257 (251-269)	
Ibid., Vol. 2, p. 254		Eq. Wt. = 211 (=266 Neut. No.)
Vegetable Fats and Oils. Jamieson, 1932, p. 129	251-263	
Ibid. p. 416	251-264	
Fats and Waxes. Hilditch, 1927, p. 91	250-260 Sap. Equiv. =216-225 (=249-260 Sap. No.)	
Edible Oils and Fats. Elsdon, 1926, p. 151	255	
Enzyclopadie der Technische Chemie, Ullmann, 1930, Vol. 5, p. 239	254-266	
Handbuch der Öle ünd Fette, Ubbelohde, 1932, Band 2, p. 559.	242-262	
Ibid., p. 560		258-273.3

A saponification number of 200 for fatty acids is equivalent to 191 for the corresponding triglyceride. In the coconut oil range, the saponification numbers of fatty acids and triglycerides differ by about 15. The inconsistencies between the two columns are apparent if this relationship is kept in mind.

A brief survey of the above few scattered references will suffice to show the chaotic state of the literature on this subject. In several cases, the distinction between glycerides and fatty acids and between neutralization, or acid number, and saponification number is not clearly made. Obviously the wide range covered by these data makes it impossible to select any one figure as typical for coconut oil glycerides or fatty acids. It is true that there is some variation due to climate and variety but the data on these points are confused and vague.

The frequency of occurrence of 258 as the saponification number for coconut oil fatty acids aroused some curiosity and it was found that this figure was obtained by Wilhelm Thörner in 1908 in the course of work on "Apparatus for Estimating the Expansion of Oils and Other Liquids which Boil over 100°." (Chem. Zentr. (1908), Vol. 79, Part 1, pp. 2001-2003). The determination of 258 as the saponification number of coconut oil mixed fatty acids presumably was only incidental to the main object of the work at hand and as such made no great claim for accuracy or that the fatty acids were typical of coconut oil generally, yet this one value has been copied more widely and given much greater publicity than it would have deserved had it been far more trustworthy. It is unfortunate that such blunders are often perpetuated indefinitely by the compilers of hand books and our plea is filed here and now for a more thorough and critical examination of such data before they are awarded a place of honor in a standard reference work.

One hundred and thirty-four samples of coconut oil mixed fatty acids examined in the Procter and Gamble Co. Laboratories over a period of several years showed 268.0 saponification number with a mean deviation of 2.6 from that value. The iodine number was 10.1 ± 0.8 and titer 23.3 ± 0.3. The two latter values attest the authenticity of the samples. The saponification number 268 corresponds to 253 for the glycerides, which are values quite in accord with the apparently more reasonable and reliable data given in the references above.

Using the values 268 and 200 for the saponification numbers of coconut oil fatty acids and other fatty acids respectively, a 50% coconut oil fatty acid mixture would have a saponification number of 234. If the coconut oil content were calculated from this value and Thörner's figure of 258, the resulting apparent percentage would be 58.6 or about 17% higher than the true content. The writer has personal knowledge of a case in which a reputable chemist, through a combination of faulty saponification number determinations exaggerated by use of Thörner's value of 258, taken from a widely used handbook, reported in a commercial soap analysis a coconut oil content more than 50% too high.

In conclusion, we submit 253 as a typical saponification number for neutral coconut oil glycerides such as are generally received and used in the United States. The corresponding saponification number of coconut oil fatty acids is 268 and these values are recommended for use in the calculation of the composition of mixtures such as has been described.