The Use of Soft Resin Content for Evaluating Hops, Humulus lupulus L.


The brewing value of hops depends largely upon the amount and quality of the lupulin which is produced by the pistillate inflorescence. In the mature strobile the outer surface of the perianth, the bases of the bracteoles and bract-like stipules are covered with this material. It may constitute from 15 to 32% by weight of the strobiles. The secretion contained in the lupulin is a complex mixture of several substances, the chief of which are (a) hop oil and (b) resins. The hop oil is an essential volatile oil, which gives the strobile its characteristic aroma. The resins in the lupulin glands are referred to as hard and soft resins. The hard resins are of no value in the brewing process, whereas the soft resins are bitter and impart this taste to the beer wort. In addition, the soft resins also prevent growth of certain types of bacteria in the wort and thus have a preservative effect. The soft resins, alpha acid and beta fraction, commonly referred to as alpha and beta resins, are derived principally from the humulon and lupulon portions of lupulin. Alpha resin consists of only alpha bitter acid or humulon, whereas the beta fraction is composed of beta bitter acid or lupulon, together with oxidation products of both humulon and lupulon. Alpha acid and beta fraction are often used in computing a formula for “preservative value”, or “brewing value”, which is a measure of the inhibitory effect of the soft resins of hops on the growth of certain lactic acid-forming bacteria in beer or wort. Preservative value has been employed by English workers but has been of limited importance in the United States. The formula is sometimes expressed by the following equation:

\[
P.V. = 10 \left(\% \text{alpha} + \frac{\% \text{beta}}{3}\right)
\]

The weighting of beta may vary, however, depending upon the investigator. Since the alpha acid and beta fraction form the present basis for computing “brewing value” it appeared advisable to obtain additional information on these lupulin components which might be of value in a hop breeding program.

Review of Literature

Investigations pertaining to the use of soft resin content for evaluating hops from a breeding viewpoint are limited. The literature on this subject is confined for the most part to the development of analytical procedures and techniques for determining the alpha acid and beta fraction. The colorimetric method used in this investigation, was originally suggested by De Wever (4) in 1930 and later modified by Fries and Philip (6) in 1939 and by Fries and Philip (7), Comrie (3), Bullis (1), and Bullis and Alderton (2).

A recent report on the deterioration of hops (10) under temperatures of 36°F to 82°F for periods of 12 months suggests that the rate of change of alpha acid was a variable characteristic. The varieties Canterbury Golding, Early Bird, and Northern Brewer decreased during the 12 months but still contained an appreciable amount. In Brewer's Gold the samples showed complete absence of alpha acid at the end of 12 months. The rate of deterioration was slightly in the same varieties from different locations.

De Wever (4) reports that hops have been used about 1500 and have been preferred to other aromatic materials because of their contribution to the quality and flavor of beer. He further suggests that the constituents which play a role in brewing are the (a) essential oils, (b) pectins, (c) tannin, (d) nitrogenous matter, and (e) the bitter substances, which are the most important components. He postulates that hops, as “Grade A hops”, etc., will be replaced by other materials.

Materials and Methods

The results from the analyses of the data from experimental trials relative to alpha acid and beta fraction were obtained in this investigation. The first source of data on alpha acid and beta fraction determinations on a total of 530 hop samples collected from several locations in Oregon, 1947, and 1948. Additionally, analyses were obtained taken from each of two randomized complete block yield tests on the variety Fuggles, grown seedless, in 1946. The analyses were of five entries (fertilizer treatments) with three replications using one- by five-hill plots (8) for each test. A random sample of strobiles were taken from each plot. Hop samples for alpha acid analyses were obtained from a planting representing 73 genetic sources of germ plasm each grown in a five-hill plot. Samples of strobiles per plot were obtained for alpha acid and beta fraction determinations. The hop samples from the four sources were analyzed following the procedures outlined by Bullis and Alderton (2). The results from these studies were computed on a moisture free basis.

Experimental Results

A preliminary study was made to investigate the relationship of the ratio of alpha acid to beta fraction resin content between 530 samples of hops from the various genetic sources of hops. These data were divided into eight classifications by years or locations.

Bartlett’s (9) Chi square test for homogeneity of variances was used for comparing the variances (\(s^2\)) which are determined from the sum of squares divided by the degrees of freedom, and these variances are compared with the standard alpha level of 0.05.