

COMPARISON OF JACKSON AND GILLIS AND DIRECT POLARIZATIONS.

By G. S. MOBERLY.

I have been requested to prepare a report on the differences between direct polarization and Jackson and Gillis polarization of mixed juice. At the outset I found the available data to be very limited. When carrying out Jackson and Gillis tests it had unfortunately not been a general practice to do a simultaneous direct polarization. My own available figures were very sketchy up to September of last season. I, therefore, circulated an appeal to all chief chemists asking for any relevant figures in their possession. The response was very disappointing, not because of any reluctance to co-operate, but because very few chemists had any information to give. What was available was in a great variety of forms, some four-hourly, some daily some weekly and some monthly, and all covering different periods of time. However, from the odd mass of assorted data I have been able to extract a little information.

The following table shows the annual average difference for certain factories in recent years, together with the standard deviation from the mean of weekly averages (+ indicates Jackson and Gillis polarization higher than direct).

Factory No.	1938.	1939.	1940.	1941.
6 Difference ...	-0.026	+0.027	+0.007	+0.001
S.D.M. ...	0.031	0.020	0.019	0.013
12 Difference ...	—	-0.012	+0.029	+0.026
S.D.M. ...	—	0.031	0.042	0.018
8 Difference ...	—	—	+0.009	+0.002
S.D.M. ...	—	—	0.038	0.015
5 Difference ...	—	+0.087	+0.109	+0.067

The figures for No. 5 are not strictly comparable as they are for the Herzfeld method, except for, one month of 1941, when the Jackson and Gillis method was used.

In the above table the annual differences for the first three factories range from -0.026 to +0.029.

From the very few figures here available it is evident that no average difference applies to any one factory for every year or to every factory for any one year. There is a similarity between the differences for 1940 and 1941, but these are contradicted by the figures of other years.

At this stage it might be advantageous to consider the value of any difference between the polarizations. With sucrose at £6 per ton each 0.1 difference of polarization is worth about 1½d. per ton of sucrose in cane, or about £46 per 1,000 tons of sucrose purchased, or 0.075 per cent. of the price of cane.

The figures for standard deviation from the mean have been given to show the probable degree of accuracy with which annual differences could be applied to individual weeks. A variation equal to twice the S.D.M. might be expected to occur about once in every 20 weeks, i.e., once or twice a season. Thus with a S.D.M. of, say, 0.025, the application of an annual correction to every week is liable to give rise to an error of 0.05 in sucrose per cent. mixed juice in one or two weeks of the season, equivalent to about ½d. per ton of cane, to the advantage or disadvantage of growers delivering more or less than the *pro rata* quantity of cane during such weeks. An error three times as great as the S.D.M. is liable to occur once every 100 weeks or once every three years.

Fuller figures based on four-hourly tests are available for certain factories, during the months of September, October and November of the 1941-42 season:—

Factory No.	September.	October.	November.
18	-0.014	-0.011	-0.003
11	-0.085	-0.069	—
14	+0.011	-0.004	+0.032
21	+0.033	+0.008	—
12	+0.007	+0.016	—

Even during this very limited period of the crop there is no agreement in the differences at different factories, positive and negative differences occurring with equal frequency.

The question arises as to what are the factors governing these differences, and one naturally supposes that they depend on the quality of the juice.

The differences shown in the first table are here reproduced, together with the purity and reducing sugar ratio of the mixed juice in each case.

Factory No.	1938.	1939.	1940.	1941.
6 Difference ...	-0.026	+0.027	+0.007	+0.001
Purity	86.5	86.2	86.2	85.8
Reducing sugar ratio ...	2.68	2.83	3.25	2.88
12 Difference ...	—	-0.012	+0.029	+0.026
Purity	—	86.4	84.5	84.3
Reducing sugar ratio ...	—	3.80	4.77	4.38
8 Difference ...	—	—	+0.009	+0.002
Purity	—	—	84.6	84.3
Reducing sugar ratio ...	—	—	3.66	3.21
5 Difference ...	—	+0.087	+0.109	+0.067
Purity	—	87.1	85.8	85.8
Reducing sugar ratio ...	—	3.36	?	?

With the very limited information in the above tables the purity of the mixed juice seems to bear no relationship to the differences. If we ignore No. 5, where the Herzfeld method was used, we can say that the lowest reported reducing sugar ratio gave the highest negative difference, and the highest reducing sugar ratio gave the highest positive difference, but between these extremes there is no sort of correlation.

At factory No. 4, where the primary and secondary juices are analysed separately, the differences have been recorded for 254 consecutive four-hourly periods during the latter months of 1941. The average difference in the case of primary juice was +0.016 and for secondary juice +0.018.

There appears to be a slight and more or less regular change in the sign of the differences throughout the season. For the factories and years shown in the first table (excluding No. 5) we find the following average differences for the various months:—

Month.	Average difference.
June	+0.017
July	+0.002
August	-0.001
September	-0.007
October	-0.007
November	+0.004

The available figures for May and December are too incomplete to allow of comparable averages, but in both months there is a marked positive difference. It would seem, therefore, that the difference is governed mainly by the degree of maturity or over-maturity of the cane, and not by the other factors which affect the purity of the juice.

In view of all the above, it would hardly seem to be practicable to abandon the Jackson and Gillis test and in place thereof to apply a correction to the direct polarization, unless this correction were determined frequently at each factory. As a possible method of procedure, I would suggest that the Jackson and Gillis test might be carried out once a day at each factory, and that the averages of all the differences for each week might be applied to the average direct polarization for the week. This would, however, cause some inconvenience in cane testing, as it would be necessary to work with a weekly Java Ratio at every factory, instead of with a daily Java Ratio as is now done at many factories.

I would also like to express the view that whereas the present shortage of laboratory staff may justify the adoption of some such expedient as a purely war-time emergency measure, the Jackson and Gillis test should not be abandoned as the standard method of polarization. My experience has convinced me that the more difficult Jackson and Gillis method is carried out with greater care and precision than the direct polarization, and in the case of the latter there is no other figure available with which to check it and assess its probable accuracy.

Mr. HENDRY said that they tried the Jackson and Gillis method for one month at his factory, but at the time they had a new cane testing staff and the results were so inaccurate that they decided to go back to the Herzfeld method.

He pointed out that the monthly average differences (in sucrose per cent. mixed juice) between the direct and Jackson and Gillis method were so small that there did not seem any necessity to do the Jackson and Gillis method.

Mr. MOBERLY suggested that the difficulty in doing the Jackson and Gillis test was probably due to the fact that it had

just been started at that particular factory. He had found, where staffs were experienced in the use of the method, results were in very good agreement.

The fact that the monthly average differences were small did not mean that big variations did not exist. These figures were the averages of a number of years containing both positive and negative differences which to a certain extent cancelled out and gave small average differences.

Mr. DUCHENNE gave the following table of differences in sucrose per cent. mixed juice between the direct polarization method and the baryta method, which was used at Umfolozi :—

	1938.	1939.	1940.	1941.
June	+0.027	+0.037	+0.031	+0.022
July	+0.063	+0.043	+0.013	+0.027
August	+0.052	-0.005	+0.020	+0.015
September . . .	+0.059	+0.0005	+0.021	+0.026
October	+0.043	+0.018	+0.016	+0.022
November	+0.040	-0.021	+0.022	+0.040
December... ..	+0.068	-0.014	+0.009	+0.035
January	+0.046	+0.005	+0.013	—
February	+0.035	-0.014	+0.011	—
Average	+0.052	+0.009	+0.020	+0.027

The baryta method therefore generally gave a slightly higher sucrose per cent. mixed juice than the direct polarization.

Mr. DU TOIT said that this paper had been fully discussed at a meeting of the Chemical Control Committee. It was felt that the differences were so irregular that it would be preferable to accept the value obtained from a direct polarization rather than to apply a doubtful correction factor. The hope was, however, expressed that it would still be possible to carry on with the Jackson and Gillis method under present conditions, as the correctness of this method was not questioned.

Mr. du Toit read a letter from Dr. Zerban to Mr. Dodds, in which the necessity of adhering to a method, once it had been adopted, was stressed.