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The ^{14}C content of the ethanol of South African wines for the years 1925—1975

by

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Der ^{14}C -Gehalt des Äthanolis südafrikanischer Weine der Jahrgänge 1925—1975

Zusammenfassung. — Es konnte gezeigt werden, daß südafrikanische Naturweine infolge der atmosphärischen Bedingungen einen niedrigeren ^{14}C -Gehalt besitzen, als ihn Vergleichsweine von der nördlichen Erdhalbkugel aus der Zeit der Kernwaffenversuche aufweisen. Es ist somit nicht gerechtfertigt, die ^{14}C -Werte der Nordhemisphäre bei Weinen der südlichen Erdhalbkugel anzuwenden.

Introduction

The work of SIMON *et al.* (1968) has shown that fermentation and synthetic alcohols can be differentiated on the basis of the ^{14}C content of such alcohols. This technique has subsequently been applied to indicate whether synthetic ethanol has been added to wines. Since most countries regard this as an undesirable practice, several countries of the northern hemisphere promulgated regulations defining limits for the ^{14}C content of the ethanol of imported wines.

Several authorities have indicated that over the years of active nuclear explosion tests, the radiocarbon content of the air and ^{14}C content of wine ethanol are higher in the northern than in the southern hemisphere (ZIMEN 1972, VOGEL and UHLITZSCH 1974). On this basis it appeared highly probable that the ^{14}C content of the ethanol of South African wines was lower than that in northern hemisphere wines for this specific period of nuclear tests. Consequently, regulations based on northern hemisphere data could result in serious international trade difficulties in this field and necessitated a relevant study to circumvent such problems.

Materials and methods

1. Sample preparation

Unfortified wines of several vintages were obtained and the ethanol collected as described in the preceding note (HANEKOM *et al.* 1978).

2. Apparatus

A Beckman LS 200B scintillation counter with ^{14}C isoset in the counting channel and an automatic unit for pre-determining the desired accuracy was used.

3. Reagents

(i) Insta-gel scintillator liquid (Packard Instruments).

- (ii) ^{14}C toluene standard (product code CFR. 8; Radiochemical Centre, Amersham, England). ^{14}C n-Hexadecane from the same supplier (product code CFR. 6) was used in initial work. No statistically significant differences in the analyses of samples could be determined when either of the two standards were used.
- (iii) Synthetic ethanol, 99,98 vol.%; for determining background counting rate (S.A.S.O.L., South Africa).
- (iv) Calibration standard: 4,683 g ^{14}C toluene/100 cm³ synthetic ethanol.

4. Counting procedure

Although a 6:14 ratio of scintillator liquid : spiked synthetic alcohol (total volume 20 cm³) gave the highest counting rate, a 10:10 ratio (total volume 20 cm³) was used for purely practical reasons. A counting efficiency of 80 % was obtained at the latter ratio.

Precisely 10 cm³ scintillator liquid and 10 cm³ ethanol sample were pipetted into new, low background-count vials, the vials were closed and well shaken to a homogeneous mixture and left for two hours in the apparatus with the lid closed, prior to counting. Counting was done for 100 min on each sample and gave a counting accuracy ($2 \times$ standard deviation) of 3 % for the lowest counting rates.

5. ^{14}C content of samples

Correcting for background, counting efficiency and determining the alcohol mass from pycnometric values the counting rate was expressed as dpm/g carbon in the ethanol. (cf. RAUSCHENBACH and SIMON 1975).

Results and discussion

The analytical data showing the variations in ^{14}C content and sample standard deviations are noted in the table.

^{14}C content of the ethanol of South African natural wines of various vintages
 ^{14}C -Gehalt des Äthanols südafrikanischer Naturweine aus verschiedenen Jahrgängen

Vintage year	Number of analyses	Avg. dpm/g C	Standard deviation
1926	3	12,8	0,46
1933	3	12,7	0,40
1946	1	13,0	—
1953	1	12,5	—
1955	3	11,7	0,56
1959	3	15,4	0,17
1960	1	14,0	—
1961	5	13,6	0,51
1962	6	14,8	0,61
1963	6	20,3	0,75
1964	5	19,2	0,43
1965	4	20,4	0,26
1966	3	19,0	0,44
1967	3	17,4	1,35
1968	3	19,5	0,35
1970	1	20,0	—
1971	3	18,9	0,06
1972	3	18,9	0,21
1973	6	18,8	0,31
1974	6	18,1	0,51
1975	6	17,8	0,68

The patterns of these data follow those of the northern hemisphere closely (COUSA LOPES *et al.* 1975, RAUSCHENBACH and SIMON 1975, ZIMEN and BRITS, personal communication). The same trend has been noted by ZIMEN (1972) for Australian wines but with a shift in peak activity which appears later than that of the northern hemisphere. Similar data have been reported by VOGEL and UHLITZSCH (1974) for the radiocarbon content of the air in the vicinity of Pretoria.

A critical aspect of this study was the maximum ^{14}C value in the ethanol of South African wines. This value was in the order of 20 dpm/g carbon which is markedly lower than that reported for the northern hemisphere viz. approximately 26 dpm/g carbon (COUSA LOPES *et al.* 1975, RAUSCHENBACH and SIMON 1975). Furthermore, it is important to note that in northern hemisphere wines, the dpm values of the years from 1963 to 1968 are all in excess of the South African maximum value. The ^{14}C content of ethanol synthesized from fossil fuel, which has not been exposed to the ^{14}C pollution of the atmosphere, is exceedingly low; consequently, admixture with wines would effect a marked decrease in the ^{14}C content of the ethanol of such wines. In northern hemisphere wines of the latter vintages, and where the vintage is known, a ^{14}C content of the ethanol which is about 10 % lower than the known value of that vintage would be an indication of the presence of synthetic ethanol (SIMON *et al.* 1968). On the other hand, southern hemisphere wines of these latter vintages would, due to the ambient conditions, be naturally lower in ^{14}C than their northern hemisphere counterparts. Consequently, examination of these wines by the yardstick of northern hemisphere ^{14}C data, would lead to clearly erroneous conclusions in the context of the presence of synthetic alcohol.

Summary

It has been shown that, due to atmospheric conditions, South African natural wines are lower in ^{14}C content than their northern hemisphere counterparts for the periods of active nuclear explosion tests. On this basis it is incorrect to apply northern hemisphere ^{14}C data to wines of the southern hemisphere.

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