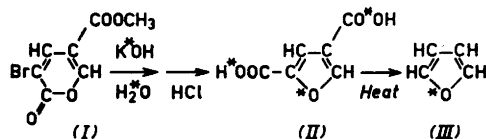


Preparation of ^{18}O -Labelled FuranBØRGE BAK, JØRGEN TORMOD NIELSEN
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Furan, enriched with respect to oxygen, has not been prepared earlier. The preparation became of interest to us in connection with structural work on the furan molecule. Here, an unambiguous determination of the oxygen coordinates with respect to the rest of the molecule necessitates that an ^{18}O -enriched sample can be investigated. The same sample is, of course, also of interest for infrared, Raman and ultraviolet spectroscopic work *etc.*

Experimental. The reaction path, found originally by Feist¹ and worked out by him for large quantities of isotopically non-enriched materials, is the following:



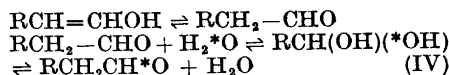
*O designates an oxygen isotope, either ^{16}O or ^{18}O , with a relative abundance of 3:1 in this experiment. O = ^{16}O .

At room temperature 1.10 g (4.8 mmole) of 3-bromocoumalic acid methyl ester¹ (I), m.p. 134.5–135.5°, was dissolved in a solution of 2.20 g (39.4 mmole) of "ordinary" KOH in 4.55 g of water, enriched to 32% in ^{18}O , the water (~242 mmole) acting as reactant and solvent. The reaction flask was flushed with dry nitrogen and heated under reflux to 120°C (oil bath) for 20 min. After cooling to liquid-air temperature, a high vacuum was established whereafter 44 mmoles of dry, gaseous HCl was condensed into the reaction mixture. Under slow elevation of the temperature the HCl applied was absorbed without difficulty, magnetic stirring of the reaction mixture being started as soon as feasible. Stirring at room temperature was continued for 30 min, after which water, methanol, and hydrochloric acid were evaporated *in vacuo* at room temperature and collected at liquid-air temperature (trap 1). The remaining mixture of (II), KBr, KCl, and possibly a small quantity of hydrochloric

acid was kept for 24 h over NaOH and P_2O_5 in an evacuated desiccator. The KBr-disc spectrum of 3 mg of the resulting dry mixture showed no sign of an organic compound other than (II).

Conversion of (II) to (III) was carried out in a 350 ml glass ampulla, following the instructions of Ref.² except for a slight change in reaction conditions (1 h heating at 250–75°C in an oil bath). After cooling, the CO_2 evolved was removed at -80°C *in vacuo* and collected at liquid-air temperature (trap 2). Thereafter, the available quantity of (III) with a trace of CO_2 was distilled off at 0°C and kept in contact with a small amount of solid NaOH which removed the trace of CO_2 in the course of 24 h. By a final distillation *in vacuo*, 85 mg of (III) (= 1.25 mmole) was collected. The infrared and microwave gas-spectra consistently showed this preparation to consist of a mixture of *ca.* 75% "ordinary" and *ca.* 25% [^{18}O]-furan. The yield of (III), based on the amount of (I) applied, was 26%.

By mass spectroscopy it was shown that the contents of trap 1, as expected, had about the same ^{18}O -abundance as (III) whereas the ^{18}O -abundance of the contents of trap 2 (carbon dioxide) was about half of this (11–12%). This is the reason for believing that the carbonyl oxygen atoms of (II) are *not* exchanged against ^{18}O . The introduction of ^{18}O into the two carboxy groups of (II) takes place during the saponification of the carbomethoxy group and the lactonic part of (I), and not at some later stage. The quantity of ^{18}O which is known to be present in (III) perhaps enters through the generally accepted mechanism:



(IV) may or may not be accompanied by replacements of the bromine atom of (I) by $^*\text{OH}$ prior to the final ring closure, but this is without influence on the ^{18}O -abundance of (III).

We are indebted to Dr. Dansgaard of the Biophysical Laboratory of the University of Copenhagen for carrying out the mass spectrometric analyses.

1. Feist, F. *Ber.* **34** (1901) 1992.
2. Bak, B., Nielsen, J. T. and Schottländer, M. *Acta Chem. Scand.* **16** (1962) 123.

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