

One-step Synthesis of the Housefly Sex Attractant (Z)-Tricos-9-ene (Muscalure)

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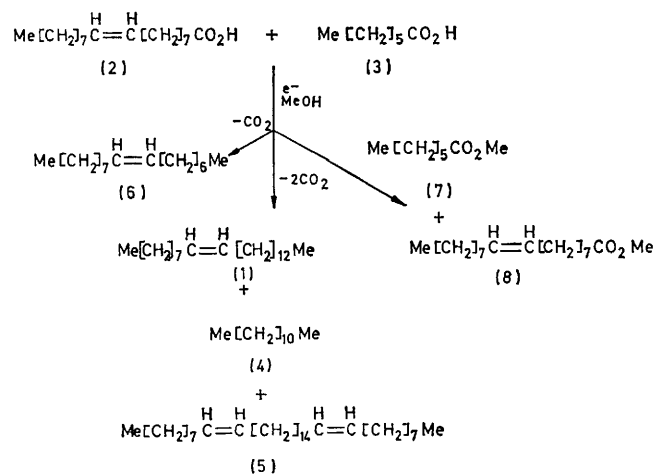
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Summary The mixed Kolbe electrolysis of oleic acid and heptanoic acid yields (*Z*)-tricos-9-ene (muscalure), the sex attractant of the female housefly, along with the other expected products.

WE describe a one-step synthesis of muscalure, (*Z*)-tricos-9-ene (**1**), the sex pheromone of the female housefly (*Musca domestica*).



SCHEME

Following the isolation and identification of the housefly sex attractant,¹ three multistep syntheses of muscalure were reported.¹⁻³ Because muscalure has been effective in field trials in attracting flies to traps⁴ and therefore may prove to be useful in fly control, we have sought to develop a practical synthesis of this important compound. We now report that a mixed Kolbe electrolysis⁵ provides a simple, one-step synthesis of muscalure from cheap starting compounds, giving material that is free of the unnatural (*E*)-isomer.

Thus, the electrolysis† of a mixture of (*Z*)-octadec-9-enoic acid (purified oleic acid) (**2**) and *n*-heptanoic acid (**3**) in methanolic sodium methoxide affords the expected products (Scheme). The neutral fraction of the mixture can be separated by fractional distillation into the coupled products (isolated yields) muscalure (**1**, 14%),‡§ dodecane (**4**, 20%),‡ and (*Z,Z*)-tetratricos-9,25-diene (**5**, 7%);§ the decarboxylated product¶ (*Z*)-heptadec-8-ene (**6**, 2%);‡§ and the esterified products methyl *n*-heptanoate (**7**, 16%)‡ and methyl oleate (**8**, 68%).‡ Since the esters can be saponified and recycled, the true yield of muscalure (**1**) is 40%.

The muscalure (**1**) thus obtained is identical (i.r., n.m.r., t.l.c., g.c.) with material obtained from the Wittig reaction between 1-bromotetradecane and *n*-nonanal.¹ The absence of (*E*)-tricos-9-ene in material prepared by the electrolysis method is shown by the absence of the 967 cm⁻¹ out-of-plane C-H bending vibration normally found in the spectrum of the (*E*)-isomer.

† Typical, but not optimized, conditions are: methanol, sodium methoxide, platinum foil electrodes, 15°, 48 V, 0.8 A.

‡ This material is identical (i.r., n.m.r.) with an authentic sample and exhibited a single g.c. peak.

§ This material shows a correct parent ion in its mass spectrum.

¶ No attempt was made to isolate hexane, the product of the decarboxylation of heptanoic acid.

The mixed Kolbe electrolysis should be applicable to the synthesis of muscalure analogues for fly control studies. For example, it has been reported⁶ that a 7:3 mixture of (1) and (Z)-heneicos-9-ene is more effective in capturing flies than muscalure itself.

We thank the Society of the Sigma Xi for partial support

of this work, and Eli Lilly, Merck, Sharp and Dohme, and the National Institutes of Health for support of our research programme. G.W.G. also thanks the National Institute of General Medical Sciences for a Research Career Development Award.

(Received, 26th July 1973; Com. 1083.)

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