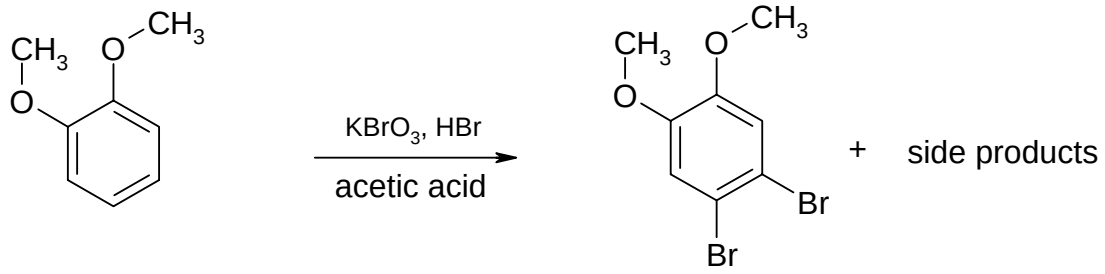
# 1005 Bromination of 1,2-dimethoxybenzene to 4,5-dibromo-1,2-dimethoxybenzene




$C_8H_{10}O_2$ (138.2)

$KBrO_3$ (167.0)
HBr (80.9)

$C_8H_8Br_2O_2$ (296.0)

## Classification

**Reaction types and substance classes**
electrophilic substitution of aromatics, bromination of aromatics
aromatics, bromoaromatics, aryl ether

**Work methods**
adding dropwise with an addition funnel, stirring with magnetic stir bar, recrystallizing, filtering

## Instruction (batch scale 30 mmol)

**Equipment**
250 mL Erlenmeyer flask, thermometer, addition funnel, heatable magnetic stirrer, magnetic stir bar, Buechner funnel, suction flask

**Substances**

| | |
|---|---|
| 1,2-dimethoxybenzene (mp 15 °C, bp 205 °C) | 4.15 g (30.0 mmol) |
| potassium bromate | 3.34 g (20.0 mmol) |
| hydrobromic acid (48%) | 12 mL (105 mmol) |
| aqueous sodium disulfite solution (0.2 M) | 20 mL |
| acetic acid (conc.) (bp 118 °C) | 40 mL |
| ethanol (bp 78 °C) | 10 mL |

**Reaction**
4.15 g (30.0 mmol) 1,2-dimethoxybenzene (veratrol) are filled in a 250 mL Erlenmeyer flask with thermometer and magnetic stir bar and dissolved in 40 mL conc. acetic acid. 3.34 g (20 mmol) potassium bromate is added which initially is not completely dissolved. Then 12 mL (105 mmol) hydrobromic acid (48%) are added dropwise under stirring. at room

temperature. Potassium bromate dissolves completely, when the temperature of the reaction mixture starts to increase to about 45 °C. The mixture is stirred for further 30 minutes at room temperature.

**Work up**
The solution is added to 100 mL ice water and stirred for further 15 minutes. The precipitation is sucked off and washed first with 20 mL of a 0.2 M sodium disulfite solution and then with 20 mL water. Crude yield: 9.2 g

The crude product is recrystallized from 10 mL ethanol and dried in the evacuated desiccator over silica gel.
Yield: 5.40 g (18.2 mmol, 61%); mp 87 °C

**Waste management**

**Waste disposal**

| Waste | Disposal |
|---|---|
| aqueous filtrate | solvent water mixtures, containing halogen |
| mother liquor from recrystallization | organic solvents, containing halogen |

**Time**
2.5 hours

**Break**
Before recrystallization

**Degree of difficulty**
Easy

## Instruction (batch scale 100 mmol)

**Equipment**
250 mL Erlenmeyer flask, thermometer, addition funnel, heatable magnetic stirrer, magnetic stir bar, Buechner funnel, suction flask, rotary evaporator

**Substances**

| | |
|---|---|
| 1,2-dimethoxybenzene (mp 15 °C, bp. 205 °C) | 13.8 g (100 mmol) |
| potassium bromate | 11.2 g (67.1 mmol) |
| hydrobromic acid (48%) | 40 mL (350 mmol) |
| aqueous sodium disulfite solution (0.2 M) | 60 mL |
| conc. acetic acid (bp 118 °C) | 133 mL |
| ethanol (bp 78 °C) | 25 mL |

**Reaction**
13.8 g (100 mmol) 1,2-dimethoxybenzene(veratrol) are filled in a 250 mL Erlenmeyer flask with thermometer and magnetic stir bar and dissolved in 133 mL conc. acetic acid. 11.2 g

(67.1 mmol) potassium bromate are added which initially is not completely dissolved. Then 40 mL (350 mmol) hydrobromic acid (48%) is added dropwise under stirring at room temperature. Potassium bromate dissolves completely when the temperature of the reaction mixture starts to increase. The solution ist stirred for further 30 minutes at room temperature.

**Work up**
The reaction mixture is addedd to 200 mL ice water and stirred for further 15 minutes. The precipitation is sucked off and washed first with 60 mL of a 0.2 M sodium disulfite solution and then with 100 mL water. Crude yield: 32.7 g
The crude product is recrystallized from 20-25 mL ethanol and dried over silica gel in the evacuated desiccator.
Yield: 23.0 g (77.7 mmol, 78%); mp 87 °C; GC-purity 100%

**Comments**
By evaporating of the solvent from the mother liquor at the rotary evaporator and recrystallization of the residue from ethanol, a small amount of a second less pure crystall fraction can be isolated. The remaining mother liquor contains mainly the side product 4-bromo-1,2-dimethoxybenzene (see analytics).

**Waste management**

**Recycling**
The ethanol is evaporated from the mother liquor, collected and redistilled.

**Disposal**

| Waste | Disposal |
|---|---|
| aqueous filtrate | solvent water mixtures, containing halogen |
| residue after evaporation of the ethanol | organic solvents, containing halogen |

**Time**
3 hours, without recrystallization and drying

**Break**
Before recrystallization

**Degree of difficulty**
Easy

## Instruction (batch scale 1 mol)

**Equipment**
4 L Erlenmeyer flask, thermometer, addition funnel, heatable magnetic stirrer, magnetic stir bar, Buechner funnel (large), suction flask, 1 L beaker, 2 L beaker, ice bath, rotary evaporator

**Substances**
1,2-dimethoxybenzene (mp 15 °C, bp 205 °C) 138 g (1.00 mol)

| | |
|---|---|
| potassium bromate | 112 g (0.671 mol) |
| hydrobromic acid (48%) | 400 mL (3.5 mol) |
| sodium disulfite solution (0.2 M) | 600 mL |
| conc. acetic acid (bp 118 °C) | 1.3 L |
| ethanol (bp 78 °C) | 200 mL |

**Reaction**

138 g (1.00 mol) 1,2-dimethoxybenzene (veratrol) is filled in a 4 L Erlenmeyer flask with thermometer and magnetic stir bar and dissolved in 1.3 L conc. acetic acid. 112 g (0.671 mol) potassium bromate is added, which initially is not completely dissolved. Then 400 mL (3.5 mol) hydrobromic acid (48%) is slowly added dropwise under stirring at room temperature. At a temperature increase to 60 °C and change in colour of the solution from yellow to brown the addition is interrupted and the solution is cooled down with an ice bath to room temperature. Then the remaining hydrobromic acid is added faster. After complete addition the mixture is stirred for 1 further hour at room temperature.

**Work up**

The reaction mixture is added to a 2 L beaker filled with 1000 mL ice water and stirred for 30 minutes. The precipitation is sucked off, filled in a 1 L beaker with 600 mL of a 0.2 M sodium disulfite solution and washed. The precipitation is sucked off again, washed in a 1 L beaker with 800 mL water and sucked off again. Crude yield: 339 g

The crude product is recrystallized from 200 mL ethanol. The product is dried in the evacuated desiccator over silica gel for some days until reaching weight constancy.

Yield: 271 g (916 mmol, 92%) 4,5-dibromine-1,2-dimethoxybenzene; mp 87 °C

**Comments**

By evaporating the solvent from the mother liquor and recrystallization of the residue from ethanol a second less pure crystall fraction can be isolated. The remaining mother liquor contains mainly the side product 4-bromo-1,2-dimethoxybenzene (see analytics).

**Waste management**

**Recycling**

The ethanol is evaporated from the mother liquor, collected and redistilled.

**Waste disposal**

| Waste | Disposal |
|---|---|
| aqueous filtrate | solvent water mixtures, containing halogen |
| residue after evaporation of the ethanol | organic solvents, containing halogen |

**Time**

1 day without recrystallization and drying

**Break**
Before recrystallization

**Degree os difficulty**
Medium (not easy because of the large volume of substances)

# Analytics

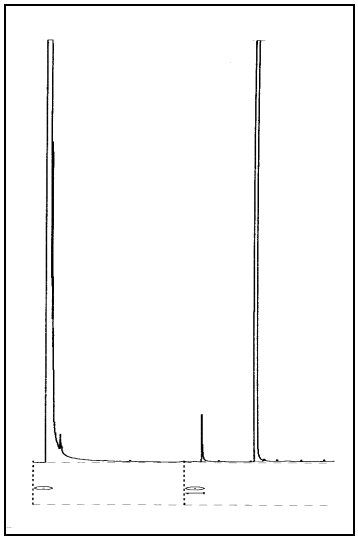
## GC

GC conditions:

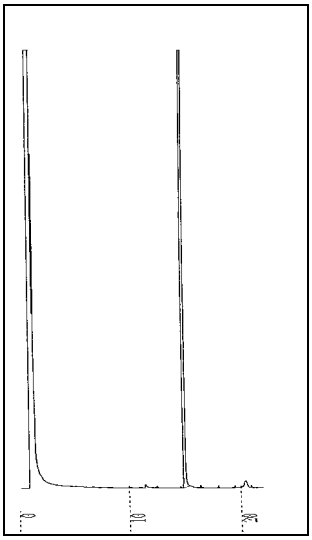
| | |
|---|---|
| column: | 5CB Low Blend/MS, length 30 m, internal diameter 0.32 mm, film 0.25 µm |
| inlet: | injector temperature 210 °C, splitinjection, injected volume 1 µL |
| carrier gas: | $H_2$, pre-column pressure 50 kPa |
| oven: | 60 °C (2 min), heating rate 10 °C/min, isotherme 240 °C (50 min) |
| detector: | FID, 310 °C |
| integrator: | Shimadzu |

Percent concentration was calculated from peak areas.

**GC of the crude product**



**GC of the pure product**

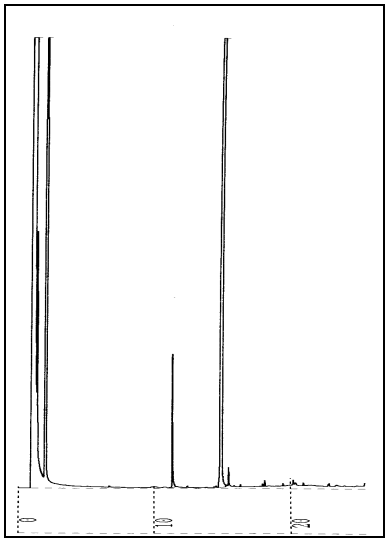


| Retention time (min) | Substance |
|---|---|
| 14.9 | 4,5-dibromo-1,2-dimethoxybenzene |
| 11.2 | 4-bromo-1,2-dimethoxybenzene |

Educt veratrol (retention time = 6.4 min) is not detected.

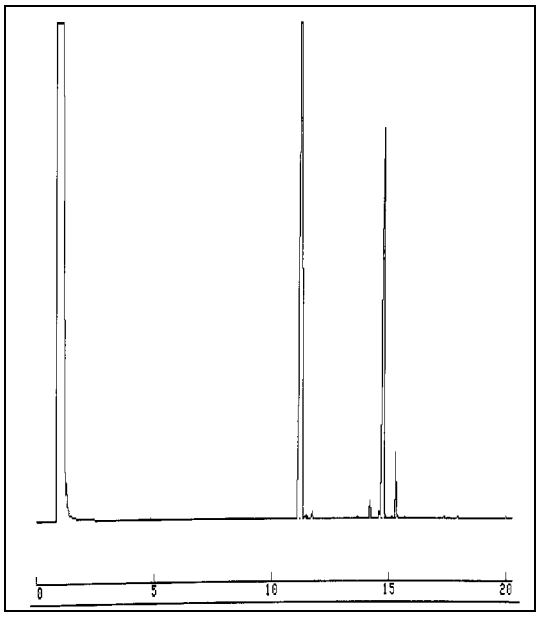
In the pure product side products are detectable only in traces.

## GC of the second crystal fraction



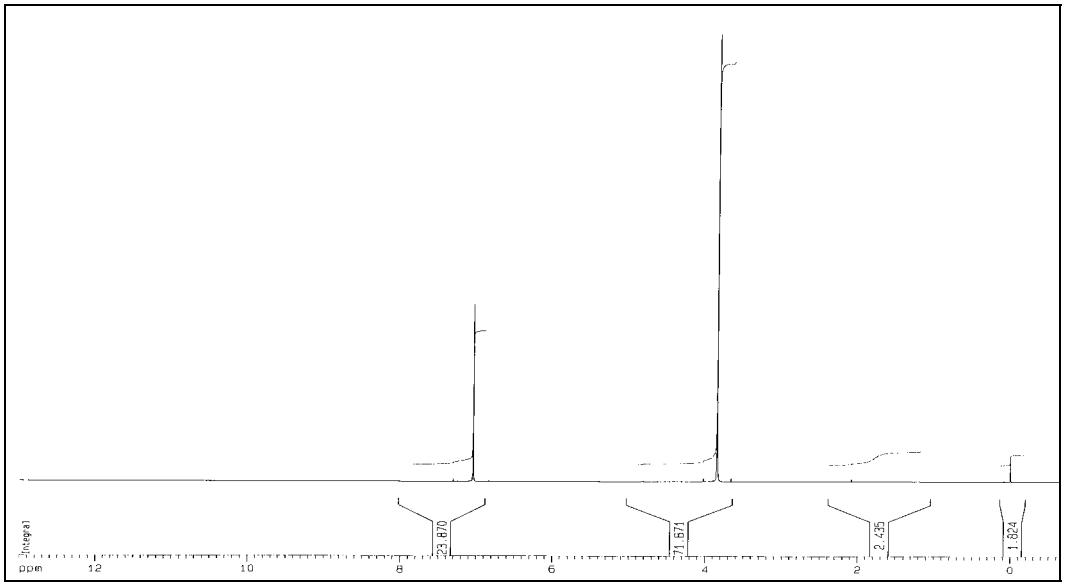
| Retention time (min) | Substance | Peak area % |
|---|---|---|
| 15.1 | 4,5-dibromo-1,2-dimethoxybenzene | 98.3 |
| 11.4 | 4-bromo-1,2-dimethoxybenzene | 1.6 |

## GC of the remaining mother liquor

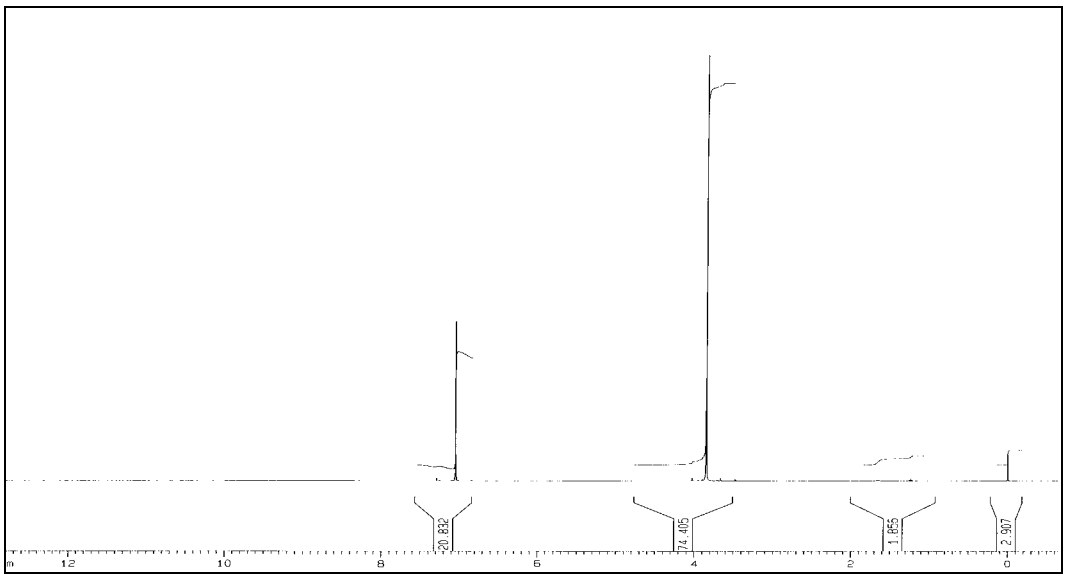



| Retention time(min) | Substance | Peak area% |
|---|---|---|
| 15.0 | 4,5-dibromo-1,2-dimethoxybenzene | 29.4 |
| 11.4 | 4-bromo-1,2-dimethoxybenzene | 66.7 |

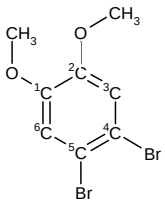
**$^1$H NMR spectrum of the crude product** (400 MHz, $CDCl_3$)



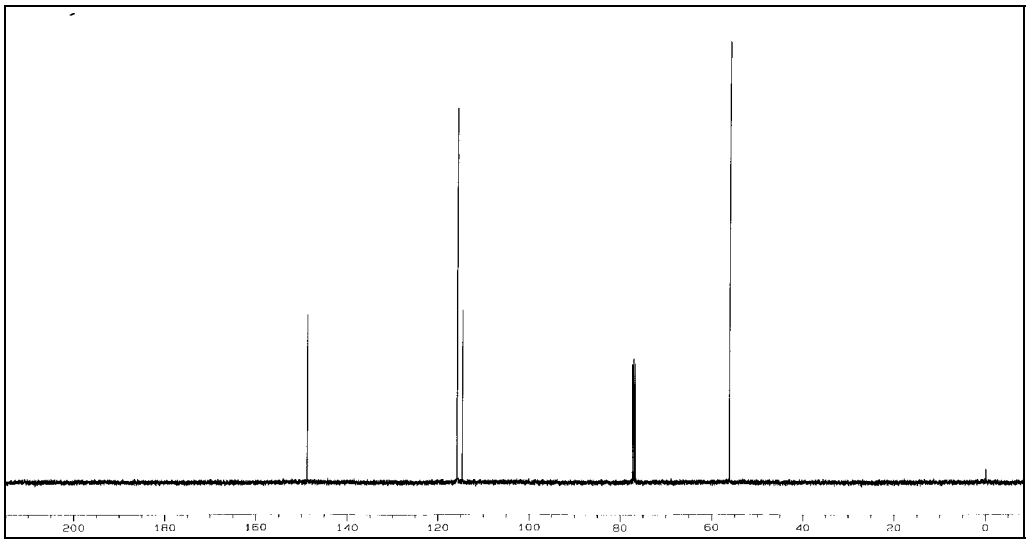

**$^1$H NMR spectrum of the pure product** (400 MHz, $CDCl_3$)



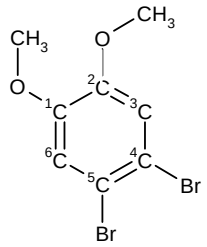

| δ (ppm) | Multiplicity | Number of H | Assignment |
|---|---|---|---|
| 3.85 | S | 6 | $CH_3$ |
| 7.05 | s | 2 | 3-H, 6-H |



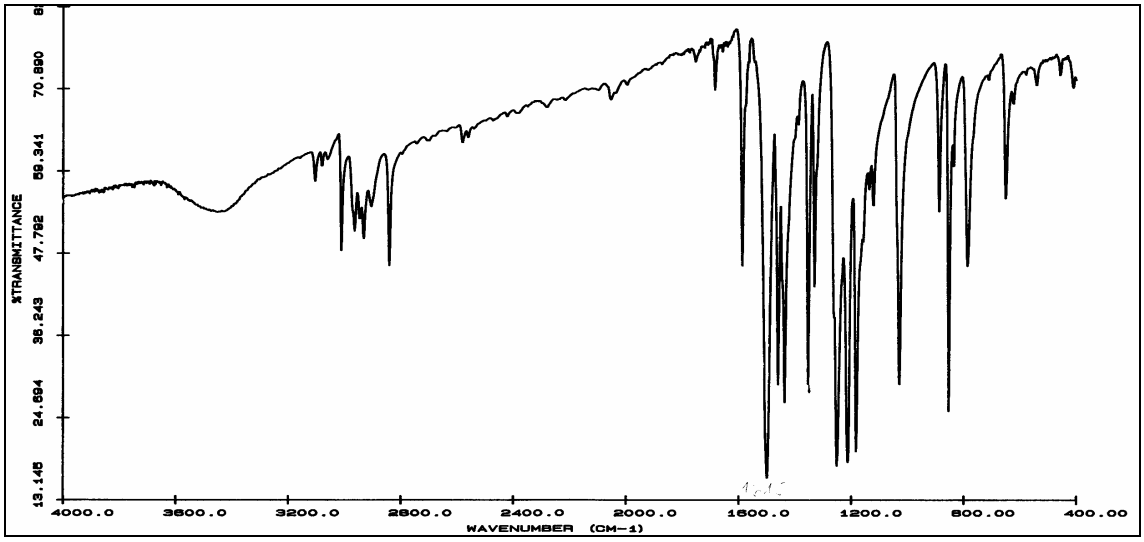
**$^{13}$C NMR spectrum of the pure product** (400 MHz, $CDCl_3$)




| δ (ppm) | Assignment |
|---|---|
| 56.14 | **C**$H_3$ |
| 114.62 | C-4, C-5 |
| 115.78 | C-3, C-6 |
| 148.74 | C-1, C-2 |
| 76.5-77.5 | solvent |




**IR spectrum of the pure product** (KBr)




| ($cm^{-1}$) | Assignment |
|---|---|
| 3100 - 3000 | C-H-valence, arene |
| 2840 | C-H-valence, alkane |
| 1585 | C=C-valence, arene |