

## THE CONVERSION OF SEMICARBAZONE OF $\alpha$ , $\beta$ -UNSATURATED ALDEHYDES AND KETONES TO 2-PYRAZOLINE-1-CARBOXAMIDES

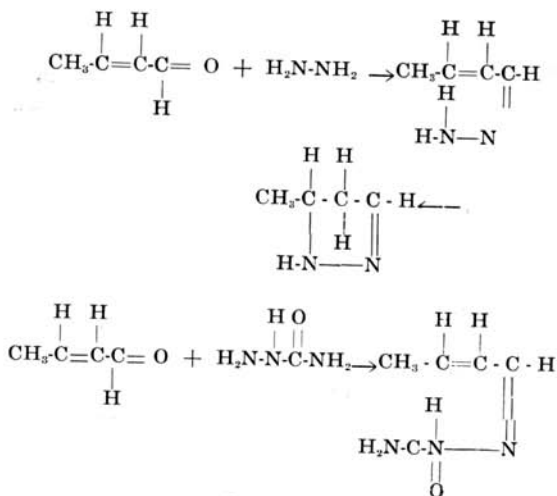
PAUL D. KLIMSTRA AND E. L. HILL  
*Augustana College, Rock Island*

### INTRODUCTION

Pyrazoline-1-carboxamides have been prepared by the reaction of unsaturated aldehydes or ketones with hydrazine to form the corresponding pyrazoline, which on treatment with potassium cyanate yielded the corresponding pyrazoline-1-carboxamides (Auwers and Heimke, 1927).

Attempts to make pyrazoline-1-carboxamides through the ring closure of the semicarbazones of  $\alpha$ ,  $\beta$ -unsaturated aldehydes and ketones have failed. It is well known that

hydrazones and phenylhydrazones of this type do rearrange to form the corresponding pyrazolines. However, it appears that if the basic character of the  $\beta$ -nitrogen of the hydrazone is reduced, ring closure is more difficult to accomplish. If a carbonyl group is substituted on the  $\beta$ -nitrogen, ring closure of the hydrazone to the pyrazoline does not seem to take place. To illustrate this, crotonaldehyde when treated with hydrazine readily forms the hydrazone and, in turn, the pyrazoline. However, when crotonaldehyde is treated with semicarbazide the



semicarbazone is formed but does not rearrange to the pyrazoline.

The objective of the phase of the research covered by this paper was to investigate the possibility of obtaining conditions whereby the semicarbazone of an  $\alpha$ ,  $\beta$ -unsaturated aldehyde or ketone can be converted to the corresponding pyrazoline-1-carboxamide.

#### DISCUSSION

Attempts to cause the rearrangement of crotonaldehyde semicarbazone were conducted by refluxing the semicarbazone in solvents of different boiling points. A common solvent used as a medium for the rearrangement of the corresponding hydrazone (or phenylhydrazone) is glacial acetic acid, b.p.  $118.1^{\circ}\text{C}$ . At the boiling point of this solvent no measurable amount of pyrazoline was obtained from the semicarbazone. It was thought that an increase in energy, supplied by refluxing in a higher boiling solvent, might bring about the ring closure. 2-ethyl-1-hexanol, b.p.  $183^{\circ}\text{C}$ ., and ethyl benzoate, b.p.  $212.5^{\circ}\text{C}$ ., were used as solvents. While the characteristic pyrazoline odor was in evidence, no measurable amount of the pyrazoline could be isolated. Crotonaldehyde semicarbazone was treated in an autoclave for 10 hours at  $100^{\circ}\text{C}$ . Again a very pronounced pyrazoline odor was observed but no measurable amount of the product was formed.

According to Maire (1908) the semicarbazone of  $\beta$ -chloroethylketone will give the pyrazoline-1-carboxamide when heated with a 10% solution of sodium acetate. The literature does not reveal any attempts

to form the chloro-aldehyde or ketone as an intermediate in the conversion of an  $\alpha$ ,  $\beta$ -unsaturated aldehyde or ketone semicarbazone to the pyrazoline-1-carboxamide. Attempts have been made during this program to do this: (1) by adding HCl-gas to the crotonaldehyde before the formation of the semicarbazone; and (2) by adding HCl-gas to crotonaldehyde semicarbazone. Procedure 1 was successful in giving a fair yield of 5-methylpyrazoline-1-carboxamide. Procedure 2 also gave the product but further investigation is required to improve the yield of pyrazoline.

#### RESULTS

##### *Pyrazolines from Hydrazones*

To develop the techniques in the laboratory procedures used for accomplishing the rearrangement of  $\alpha$ ,  $\beta$ -unsaturated hydrazones to pyrazolines, several such reactions were carried out.

*5-Methyl-2-pyrazoline.*—This compound was prepared using a mole/mole ratio of 95% hydrazine and crotonaldehyde in absolute ethanol. The product boils at  $73^{\circ}\text{C}$ . and 55 mm.

*1,5-Dimethyl-2-pyrazoline.*— This compound was prepared using a mole/mole ratio of methylhydrazine and crotonaldehyde in absolute ethanol. The compound boils at  $124\text{--}127^{\circ}\text{C}$ . and 760 mm.

##### *Pyrazolines from Semicarbazones*

*Crotonaldehyde Semicarbazone.*— This compound was made by reacting crotonaldehyde and semicarbazide-HCl in a mole/mole ratio in absolute ethanol and

sodium acetate. The resulting crystals were recrystallized from 25% ethanol-water solution, m.p. 199°C.

*5-Methyl-2-pyrazoline-1-carboxamide.*—*Procedure 1.* Five grams of HCl-gas were dissolved in 10 grams of crotonaldehyde in 80 ml. of glacial acetic acid. The  $\beta$ -chlorobutyraldehyde was treated with a mixture of 11 grams of semicarbazide-HCl and 15 grams of sodium acetate. The  $\beta$ -chlorobutyraldehyde semicarbazone was treated with an additional 11 grams of sodium acetate to remove the HCl formed during ring closure. The resulting solution was heated on a steam bath, then cooled, and the product extracted with ether. The 5-methyl-2-pyrazoline-1-carboxamide melted at 165-168° (Auwers and Heimke, 1927).

*Procedure 2.*—Two grams of HCl-gas were dissolved in a solution of four grams of crotonaldehyde semicarbazone in absolute ethanol. The exothermic reaction was controlled by cooling. To this solution was added 2.5 grams of sodium acetate; the mixture was heated on a steam

bath for one hour. The salts were precipitated by adding ether to the solution. The ether-alcohol solution was reduced in volume and a small quantity of precipitate was isolated which melted at 165-167°C. This was identical with the 5-methyl-2-pyrazoline-1-carboxamide formed in Procedure 1.

#### CONCLUSIONS

1. 5-Methyl-2-pyrazoline-1-carboxamide could not be obtained from crotonaldehyde semicarbazone by the usual methods employed to convert  $\alpha$ ,  $\beta$ -unsaturated aldehyde or ketone hydrazones or phenylhydrazones to the corresponding pyrazolines.
2. 5-Methyl-2-pyrazoline-1-carboxamide can be obtained by addition of HCl-gas to crotonaldehyde semicarbazone followed by treatment with sodium acetate and heat. Further investigation of this reaction should be carried out to improve the yield of the pyrazoline.

#### LITERATURE CITED

- AUWERS, K. V., and P. HEIMKE. 1927. Pyrazolines. *Ann.*, 458: 186-220.  
MAIRE, M. 1908. Reactions of  $\beta$ -chloroethyl and vinylketones. *Bull. Soc. Chem.*, 3(4): 272-80.