EFFECTS OF DRYING PLATFORM ELEVATION AND SIZE OF MEAT ON THE RATE OF COPRA DRYING

Aida C. Mantilla and Tung Ly

Former B.S. Agricultural Engineering student and Acting Director, Regional Coconut Research Center, Visayas State College of Agriculture, ViSCA, Leyte, Philippines.

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ABSTRACT

Among the different drying platform elevations tested (0.9 m, 1.08 m, 1.24 m), the 1.24 m elevation was found to produce copra of lowest moisture content when drying did not exceed 16 hr. The copra moisture content was not significantly affected by elevations when drying was prolonged to 18.5 to 23.5 hr. Meat sizes did not bring about any significant difference in the drying rate. The NIST Modified Dryer with coconut shells as fuel was used for drying copra.

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KEY WORDS: Copra. NIST Modified Dryer. Platform elevation. Meat size. Drying rate.

INTRODUCTION

The main product of coconut is its dried meat or copra. Copra-making is one of the weakest links in the effort to upgrade Philippine coconut products and to secure a more competitive position in the world market. Over the years, various types of copra dryer and several methods of drying have been developed and recommended (PCARR and PCA, 1978). Among these dryers, the NIST Modified Dryer (Lotho, 1978) appears to be within the reach of the small and poor coconut planters. The drying chamber is an excavation in the ground, easy to construct and heat leak-proof. This design is specifically suitable to the conditions of Eastern Visayas where most of the coconut lands are rolling to hilly.

The Regional Coconut Research Center of ViSCA constructed one unit of this copra dryer for evaluation purposes. Several "cooking" trials had been made. Results obtained from these trials were encouraging. However, it was felt that the drying platform elevation (distance from platform to bottom of drying chamber) of this dryer which was about 0.93 m may not be the optimum one. There is still a need for empirical data on this aspect.

Theoretically, the rate of moisture loss in drying increases with increase in surface area. That means, the smaller is the size of coconut meat, the faster is its drying rate. This theory is supported by the results obtained by Palmer (1968) and de Vos (1956) as cited by Lozada (1978a). Contrary to these results was the finding obtained by Lozada (1978b). He found that there were no significant differences in the rate of drying of coconut meat at different sizes. The above literature suggests that the effect of meat sizes on drying rate needs to be studied more carefully.

This experiment was conducted to study the effect of platform elevation and size of coconut meat on the rate of copra drying using a semi-direct copra dryer.

MATERIALS AND METHODS

Dryer.— A dryer similar to the NIST Modified Dryer (Lotho, 1978) was constructed with the following modifications: (1) The platform was made of bamboo slats with coconut lumber as support. The width of each bamboo slat was 1.5 cm and the distance between 2 adjacent slats was 0.6 cm. Its effective dimension was 2.4 m by 1.5 m, (2) The firing chamber was made of a whole and empty gasoline drum of 120-liter capacity, (3) A 1.5 m long chute made of G.I. sheet was made to hold the coconut shells which were packed close to each other for fueling. The chute was fixed in an inclined position forming an angle of about 35 to 40 degrees with the horizontal line, and (4) The platform elevation was adjustable.

Experimental Nuts.— Only mature and ungerminated nuts harvested from Baybay Tall population (Baliñgasa and Carpio, 1976) were used for the experiment.

Treatments and Experimental Design.— The split-plot in a Randomized Complete Block Design was used. Three platform elevations (0.93 m, 1.08 m, and 1.24 m) were assigned as main plots. The sizes of coconut meat (one-half and one-eighth of the whole nut) were assigned as the subplots.

There were 4 replications (drying batches) for every elevation. In each drying batch, the factor of meat sizes was imposed on the stage 2 (see *Drying Procedure*) of drying. Therefore, a total of 12 drying batches, each having about 600 to 700 nuts, were used in the experiment.

Drying Procedure.— The procedure recommended by Ly (1980) were generally followed with modifications to meet the required treatments. The drying of dehusked nuts was done in 2 stages as follows:

1. Stage 1 (first day)
   a) Dehusked nuts were split into halves. In splitting,

contamination of fresh meat with dirt was minimized.

b. The halves were arranged in 5 layers on the drying platform following the "Carsucho" system (Lotho, 1978).

c. Steps (a) and (b) above were started and finished within 4 hr in the morning.

d. Firing was started as soon as the arrangement of halves was completed and was continuous for 10 hr.

e. Overnight cooling was allowed after 10 hr of continuous firing.

2. Stage 2 (second day)

a. Parallel to the length of the drying platform, a string was fixed immediately above the topmost layer of halves such that the total number of halves on the platform was divided into 2 equal groups.

b. The 2 groups of halves were unloaded separately, layer by layer.

c. After the drying platform was emptied, a thin piece of plywood (3 mm thick) was fixed along the length of the center of the drying platform. Thus, the entire area of the platform was made into 2 equal compartments.

d. The half-cooked meat was removed from the shell. This was done layer by layer for each group of halves.

e. To obtain the one-half size meat, the halves in one group were not chopped. They were marked according to layer and returned to one compartment of the platform with the least dried layer of meat placed at the bottom.

f. To obtain the one-eighth size meat, each half in the second group was cut into 4 equal pieces. The pieces were marked according to layer and returned to the second compartment with the least dried layer of the meat placed at the bottom.

g. Immediately after the reloading was finished, firing was continued for 13.5 hr.

Data Collection.— Drying temperatures (temperature immediately below the bottom layer) were recorded every hour during the drying process. The measurement of temperature was done by installing 6 thermometers distributed throughout the entire area of drying platform. The hourly drying temperature was the average of 6 thermometer readings. Temperature at the topmost layer of coconut meat was also recorded hourly during the second stage of cooking. To do this, 3 thermometers for each meat size were placed equidistant from the sides of each compartment.

The moisture content (M.C.) of copra in each layer was determined at 16, 18.5, 21, and 23.5 hr of drying. For each layer, 15 pieces of copra were taken at random from which 3 composite samples were obtained for M.C. determination using the Direkto Moisture Meter (Model 11, 2001 Taft Ave., Pasay City, Philippines). The M.C. of a layer was computed by getting the average M.C. of the 3 composite samples obtained from that layer. The M.C. of copra produced in each treatment (consisting of 5 layers) was the total M.C. of 5 layers divided by 5.

RESULTS AND DISCUSSION

Data on moisture content of copra as affected by platform elevation and meat size were analyzed statistically for each sampling time. Results of these analyses revealed that the interaction effect between elevation and meat size was not significant at all sampling times. The effect of each factor on drying rate of coconut is discussed separately as follows:

Platform Elevation and Drying Rate.

Wide differences of M.C. of copra as affected by platform elevation were observed at 16 hr of drying (Fig. 1). Statistical analysis revealed that the percent moisture of copra (11.5%) produced by the 1.24 m elevation was significantly lower than the M.C. of copra (from 13.7 to 14.4%) produced by the other 2 elevations.

It was observed that the higher the elevation, the more was the fuel (coconut shells) consumption. Probably, higher platform elevation effected a better natural draft that led to a faster rate of shell burning, hence the fuel consumption was higher. As a consequence, the average drying temperature recorded for the entire drying duration at 1.24 m elevation was 1.4°C and 1.7°C higher compared to those recorded at 0.93 m and 1.08 m elevations, respectively. The faster rate of drying at 1.24 m elevation could be attributed therefore to a higher drying temperature together with better natural draft.

As the drying was prolonged, such differences were narrower until almost negligible at the end of the drying process (23.5 hr). From 18.5

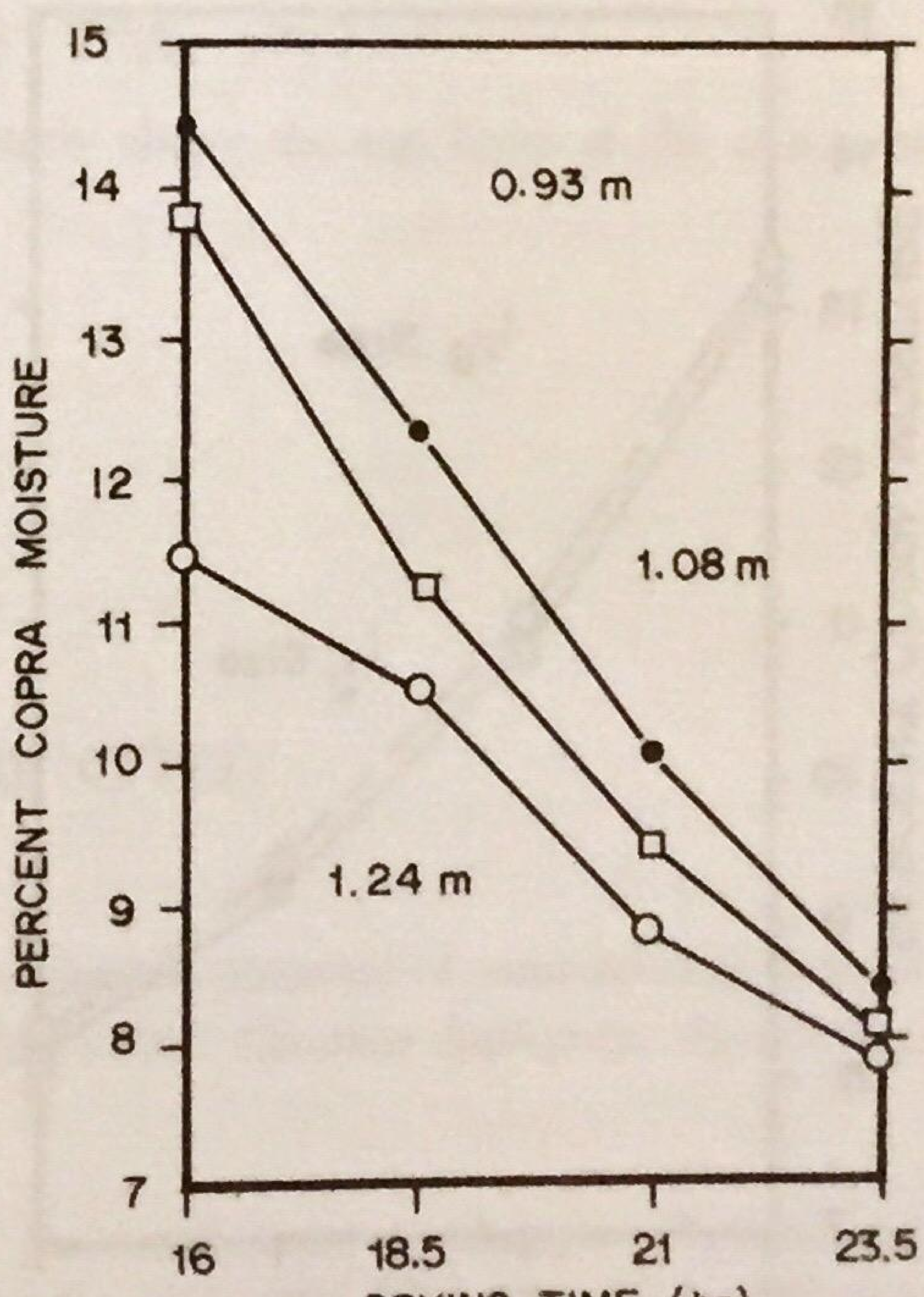

Fig. 1. Percent copra moisture as affected by platform elevation and drying time.

to 23.5 hr of drying, the platform elevations did not show any significant effect on the drying rate of coconut meat (Fig. 1).

Meat Size and Drying Rate.

The effect of meat size regardless of platform elevations on drying rate of copra is shown in Fig. 2. It can be observed that the loss of moisture from copra was consistently faster in the one-half size although the difference in rate of moisture loss brought about by different meat sizes was not statistically significant. This result agrees with that of Lozada's (1978b). Hourly drying

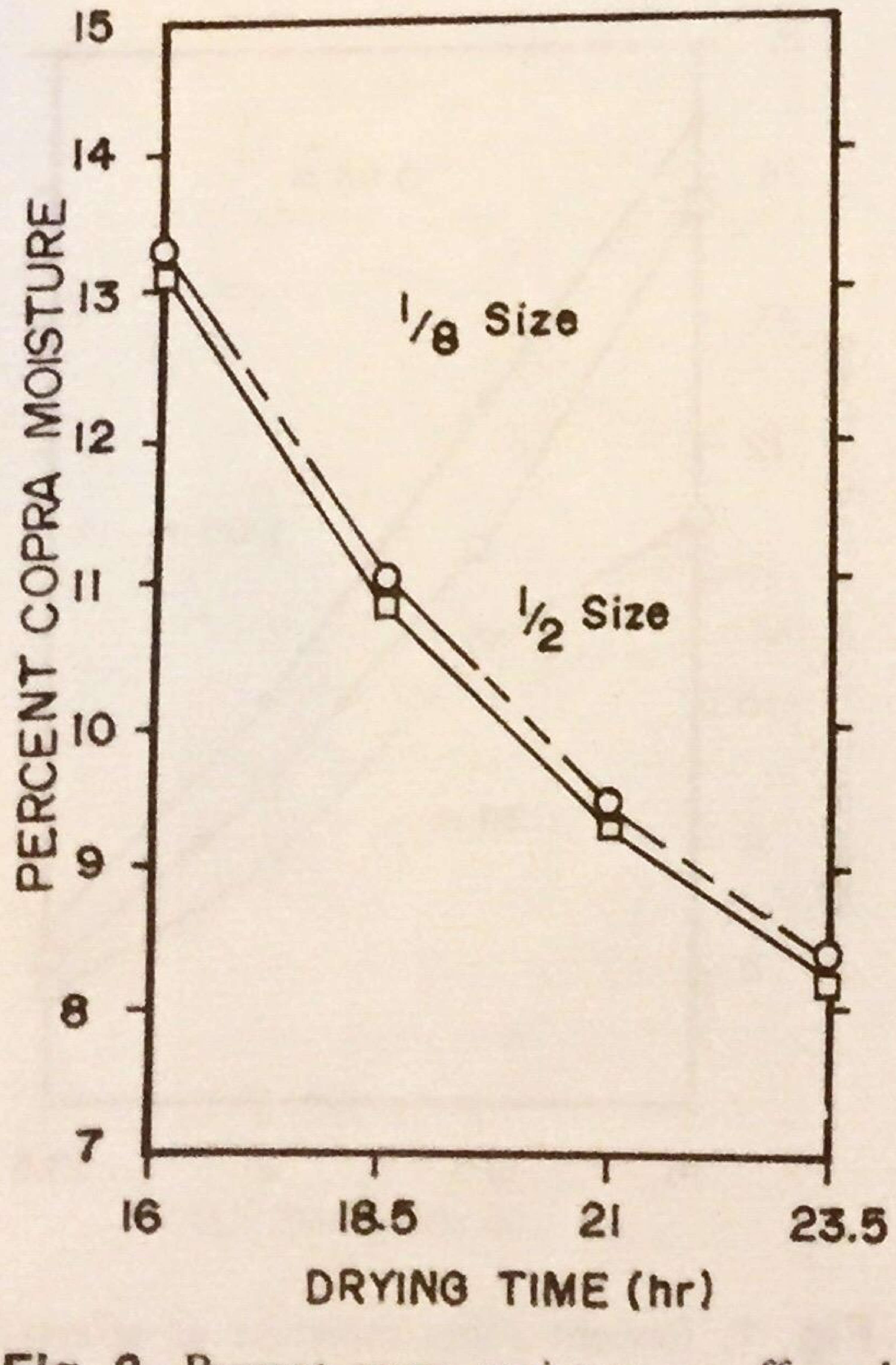

Fig. 2. Percent copra moisture as affected by meat size and drying time.

temperatures between the two compartments containing the two meat sizes were found not to differ significantly from each other. Therefore, varying the meat size in this experiment could affect the rate of moisture loss by: (a) changing the resistance to the flow of heat through the load of meat, and (b) changing the surface area of meat in contact with the hot-drying air.

In terms of surface area, the one-eighth sized meat had a much bigger surface area for mass transfer (loss of water) than the one-half sized meat. Hence, the rate of moisture loss should theoretically have been faster in the smaller-sized meat.

However, in terms of resistance to heat flow, the smaller-sized meat was found to offer higher resistance as supported by the difference in temperature recorded immediately above the top layer of the two meat sizes (Fig. 3).

Empirical data obtained in this experiment seemed to suggest that the expected faster rate of moisture loss due to increased surface area in smaller-sized meat was offset by the higher resistance to heat flow due to more compacted arrangement of the smaller pieces of meat.

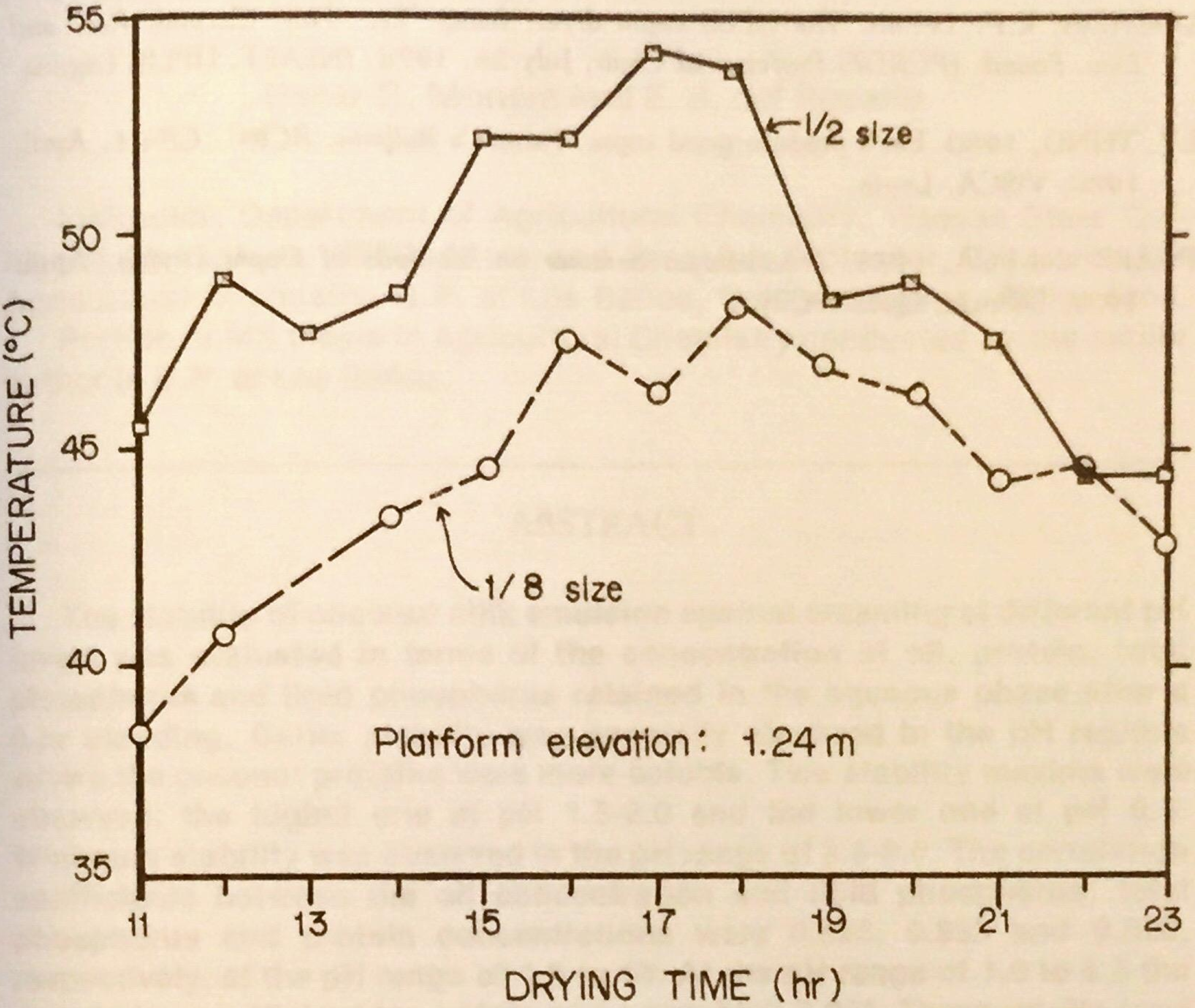

Fig. 3. Hourly temperature measured immediately above the top layer of the two meat sizes.

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