CassavaTECH

# EFFECT OF AIR-DRYING TEMPERATURES ON CYANIDE REMOVAL

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## ABSTRACT

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Cassava is an important staple food in many tropical and sub - tropical countries but it contains cyanides which prevents oxygen utilization by the cells. Cyanide removal from cassava before consumption is an integral part of its processing. This study aimed at influence of different temperature regimes (45, 60 and 75 °C ) on the cyanide contents of two cassava varieties (TME 1 and 91/02324). Freshly harvested roots were washed, peeled and their initial cyanide contents were determined using standard method. This was followed by shredding (5mm thick), spreading of chips on trays separately and oven drying at 45, 60 and 75 °C. for five hours. Cyanide contents were determined as drying progressed. Results showed that TME 1 had lower cyanide content (7.38 mg HCN/100g) than 91/02324 variety (18.55 mg HCN / 100g). Drying of TME 1 chips at 45, 60 and 75 °C resulted in cyanide reduction. However, maximum cyanide elimination occurred when 91/02324 cassava chips were dried at 75 °C. The data obtained also showed that the effect of temperature on the rate constants describing cyanide loss followed Arrhenius relationship. Activation energy values for the cyanide destruction were 1.115 KJ/mol and 2.129 KJ/mol for TME 1 and 91/02324 cassava varieties respectively.

## INTRODUCTION

Cassava (Manihot esculenta, Crantz) is playing important role in reducing hunger but it is high in cyanide (IITA, 1990). It provides about 40% of all the calories consumed in Africa and ranks seconds only to cereal grains as major energy source in Nigerian diet (Ngodddy, 1989). Cassava root, which is the main economically useful part of cassava plant, does not only store cyanogenic glucosides that are synthesized in the leaves (Mkpong et al., 1990), it is also rich in carbohydrate (80-90% on a dry weight basis) of which 80% is starch (Gil and Buitrago, 2002). Sucrose, maltose, fructose and glucose are also present in cassava in trace amount (Tewe and Lutaladio, 2004). Although cassava is a valuable source of food, its cyanide and anti-nutrients interfere with digestion and nutrients uptake (Wobeto et al., 2007). Cyanide is toxic to human and can cause serious health disorders (Montagnac et al., 2008). However, different cassava varieties contain varying amounts of cyanide (James et al., 2012). Bitter varieties have higher cyanide contents than the sweet varieties. In fact, the cyanide content of the bitter varieties exceeds the permissible level of 10 mg HCN / kg DW recommended by Food and Agriculture Organization/World Health Organization (1991). About 10-500 mg HCN equivalents/kg DW is present in its root parenchyma (Siritunga and Sayre, 2003), and ingestion of 50-100 mg cyanide has been associated with acute poisoning that could be lethal to adults (Halstrom and Moller, 1945).

In order to make cassava roots safe and suitable for consumption, removal and or destruction of violent protoplasmic poison in it called cyanide is inevitable. To achieve this, many studies have investigated potential of different processing methods in either cyanide removal or destruction (Nambisan and Sundaresan, 1985; Nambisan, 1994; Oke, 1994; Mingi and Bainbridge, 1994; Essers et al., 1995; Cardoso et al., 1998)

In Nigeria, cassava roots could be processed into diverse forms of products such as gari, fufu, lafun, sipipa, kokori, tapioca etc using different processing techniques such as soaking, boiling, fermentation and drying using either sun or oven (Bourdoux et al., 1982; Montagnac et al., 2008). The potential of air drying and other processing steps to reduce the toxic cyanogenic glucoside to below the lethal dose of hydrogen cyanide for human is important in order to ensure safety. Similarly, air-drying of cassava reduces moisture and therefore, promotes its storability (Westby, 2002). Shredding of cassava roots into chips increases its surface area, reduces drying time and promotes cyanide removal from the fresh roots (IITA, 1996). Thus, the objectives of this work are to determine the effects of different drying temperatures on cyanide removal from the two cassava varieties (TME 1 and 91/02324) and activation energy requires for drying these roots.

## MATERIALS and METHODS

**SAMPLE COLLECTION**

Freshly harvested TME 1 and 91/02324 cassava varieties were collected from International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State, Nigeria.

**CYANIDE DETERMINATION**

Procedure described by Essers *et al.*, 1993

- Extract preparation
- Preparation of linamarin standard and colour development
- Absorbance determination and standard curve preparation

**EQUIPMENT**

pH meter, analytical balance, oven and spectrophotometer

**REAGENTS**

Cold 0.1M Orthophosporic acid, Linamarin powder, 0.1 M Phosphate buffer and 0.2N NaOH

## ANALYSES

### Linamarin standard Curve

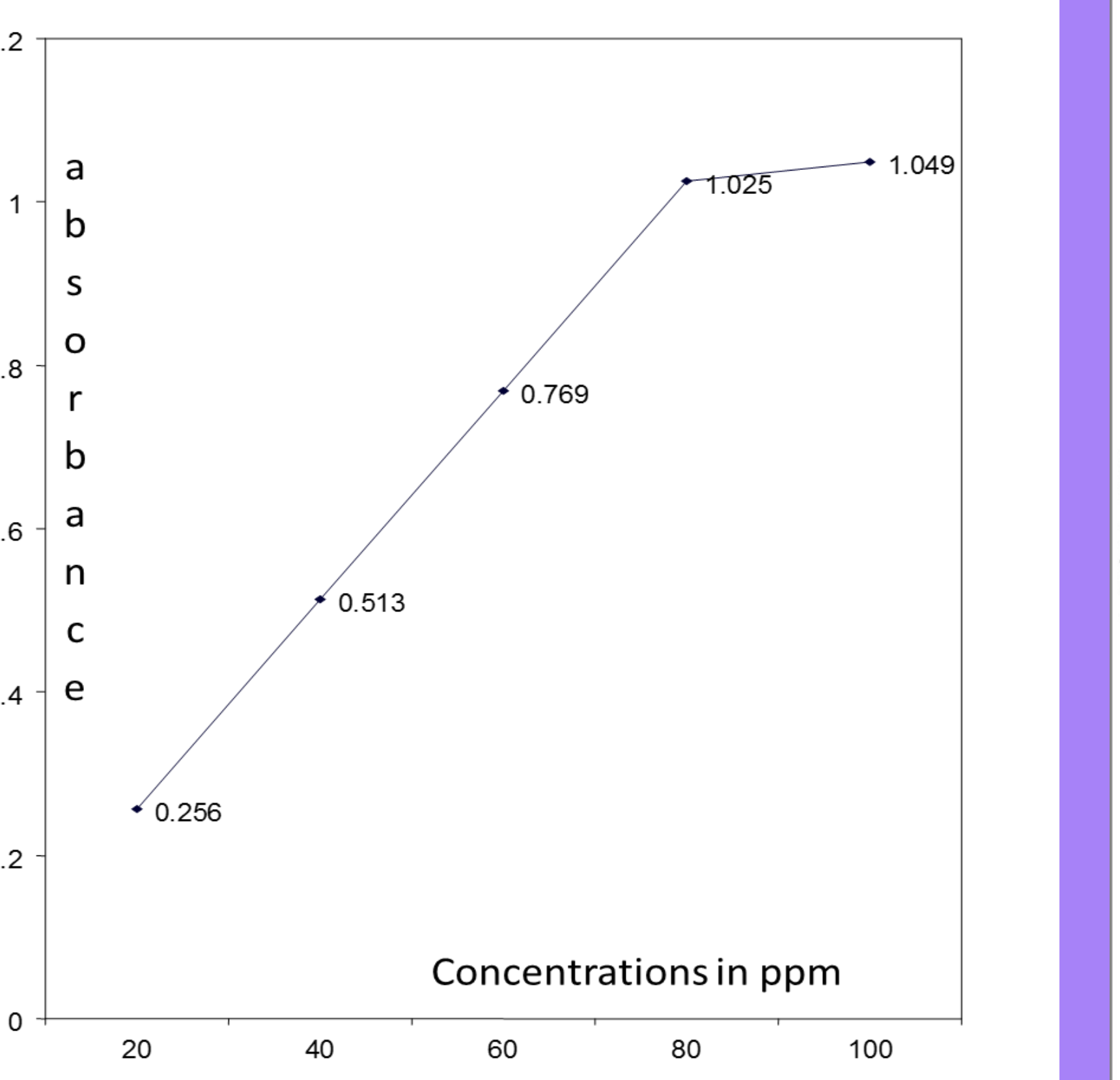

Figure 1: Linamarin Standard Curve

### First Order Model For TME 1

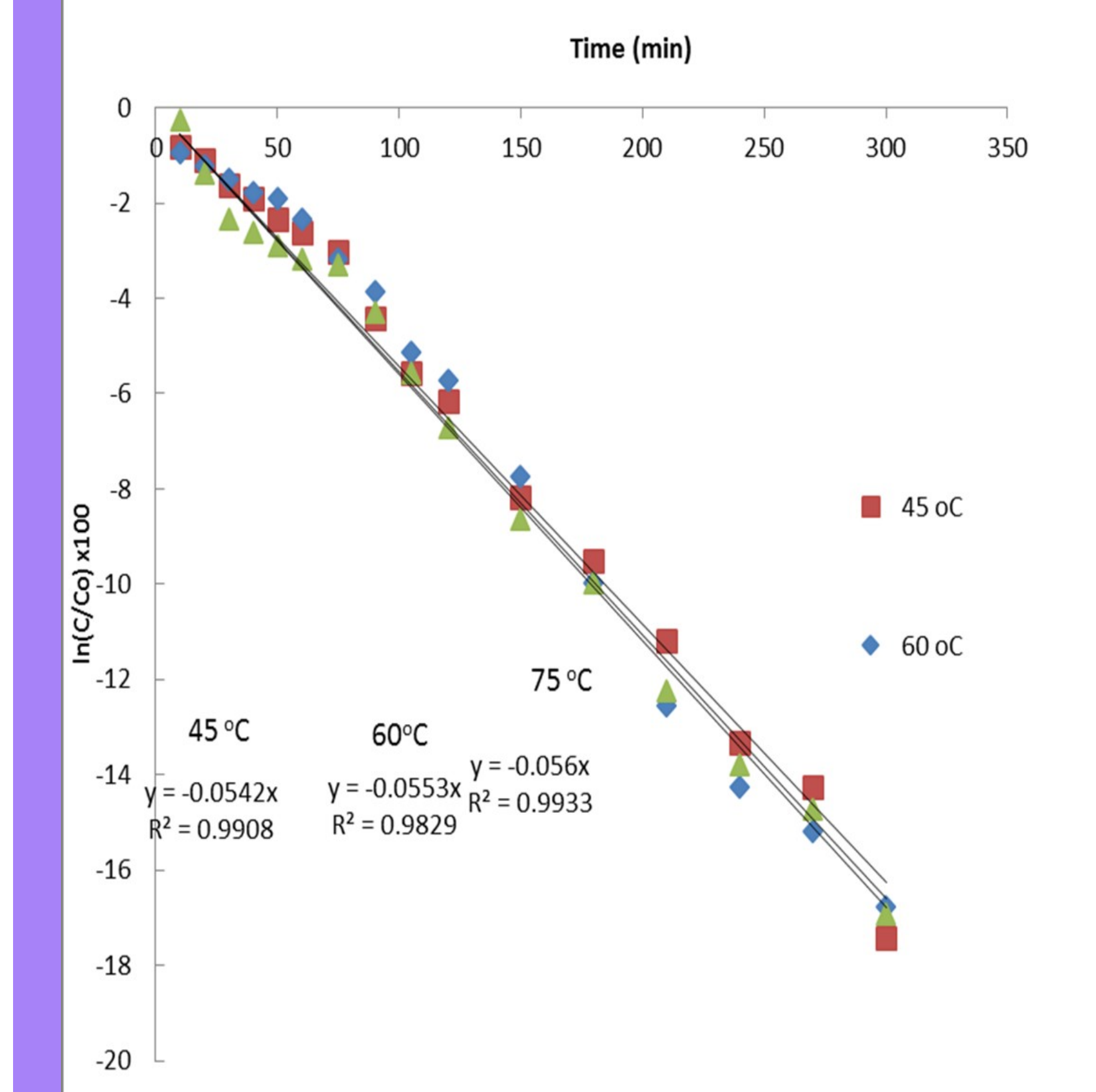

Fig. 2:First-order destruction kinetics of cyanide in dehydrated cassava ,TME1

### Arrhenius Plot

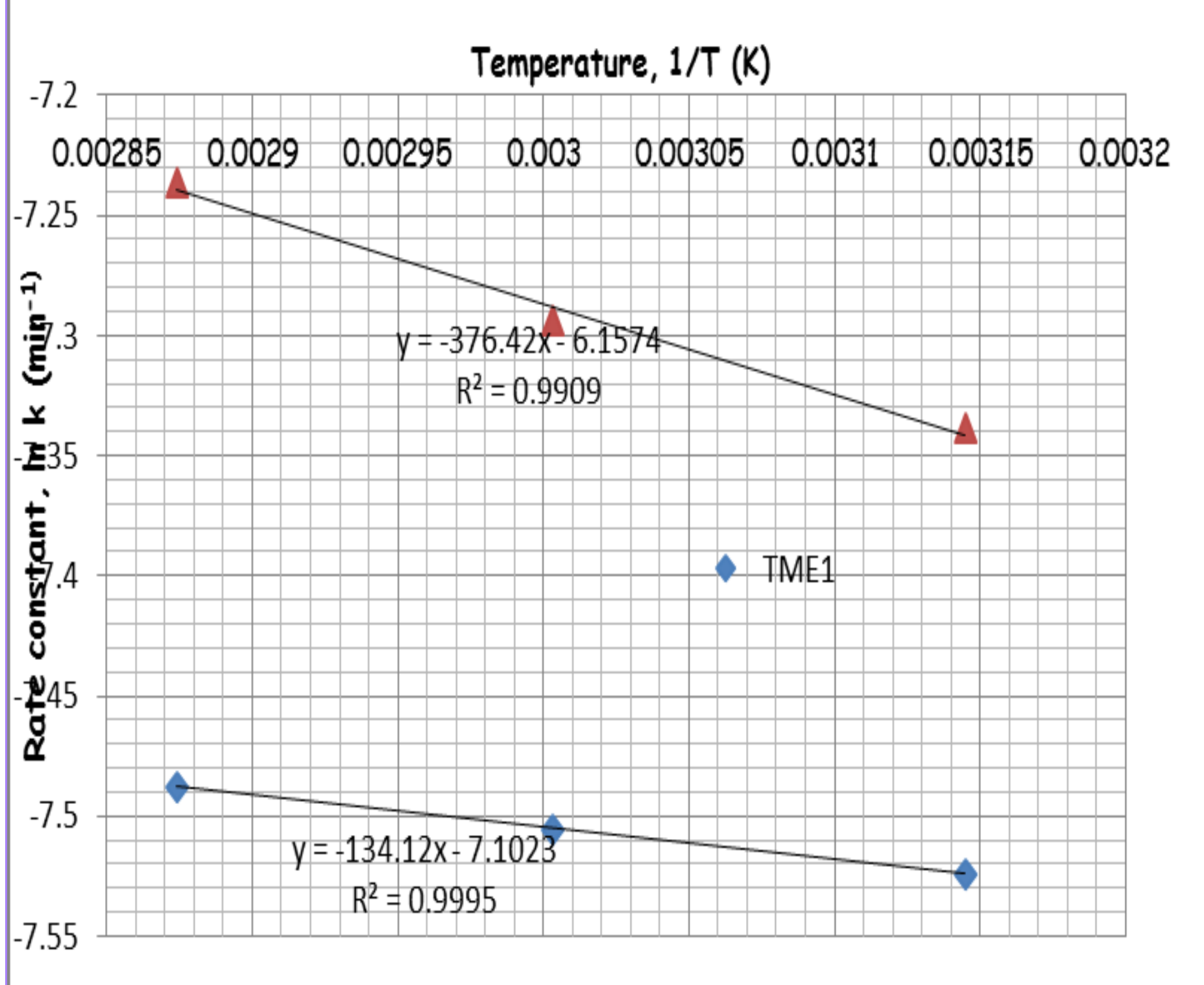

Fig. 4: Arrhenius plot for the loss of cyanide in cassava during dehydration

### First Order Model for 91/02324

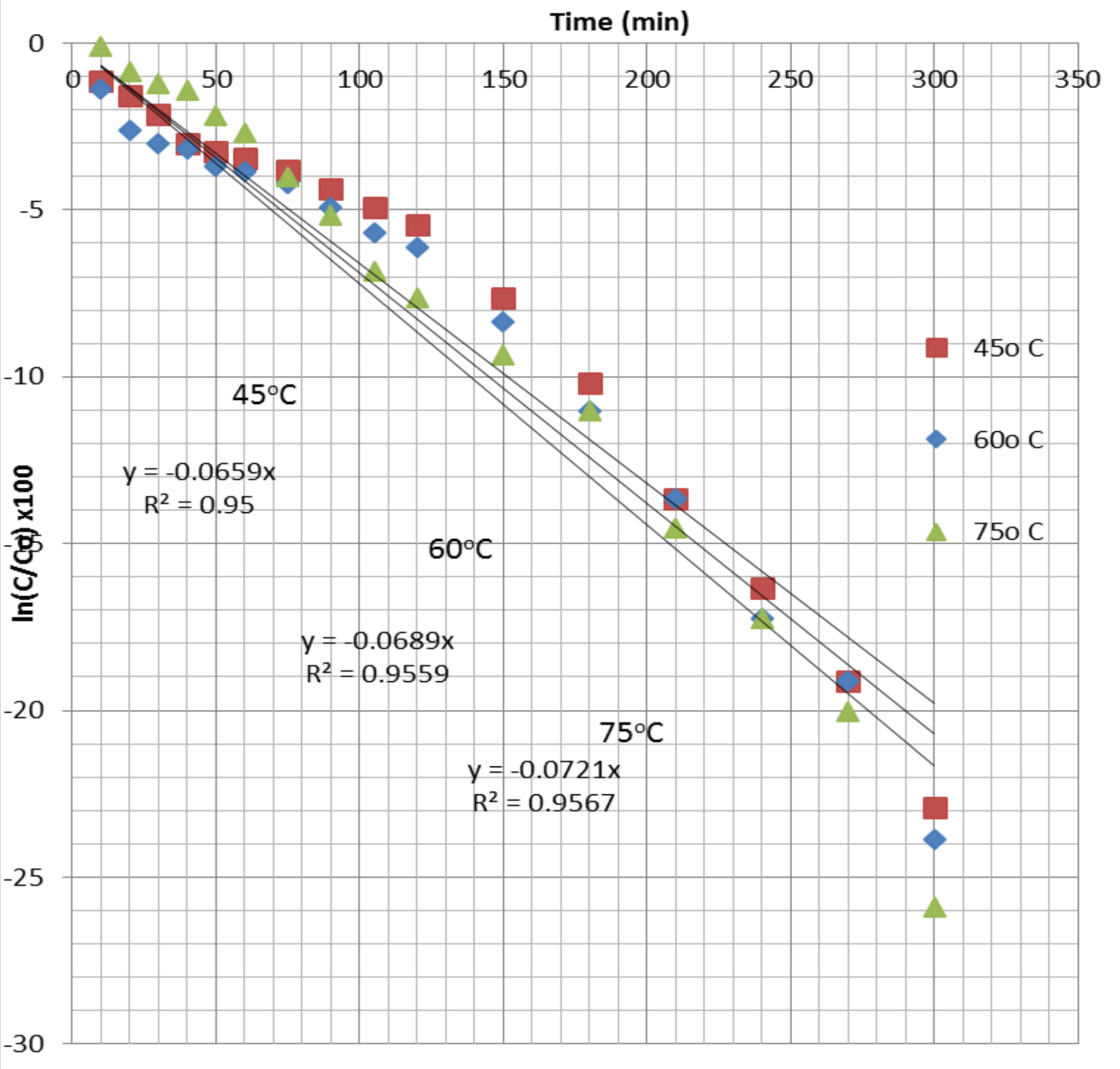

Fig. 3: First-order destruction kinetics of cyanide in dehydrated cassava ,91/02324

## CONCLUSION

From the study, the results obtained indicated that the three temperatures had potential to remove cyanide from TME 1 cassava variety while drying of 91/02324 cassava chips at 75 °C resulted in maximum cyanide elimination.

## PREPARATION OF LINAMARIN STANDARD CURVE

Linamarin standard curve was obtained by plotting absorbance readings against concentrations of

## FIRST ORDER MODEL

$\ln C/C_o = -kt$ where k is the temperature dependent rate constant($s^{-1}$)

## ARRHENIUS RELATIONSHIP

$\ln K = \ln A_o - (E_a / RT)$ where $E_a$ is the activation energy, R is universal constant (8.314 J $mol^{-1}$ $K^{-1}$

## RESULTS and DISCUSSION

The cyanide content of TME 1 cassava chips was 7.38 mg HCN/100g while 91/02324 cassava variety contained 18.55 mg HCN /100g. Drying of the two cassava varieties at 45, 60 and 75 °C for five hours resulted in cyanide reduction. This can be explained by the removal of water from the chips which resulted in the elimination of the cyanogenic glucosides which are water soluble and volatile.

As temperature and drying time were increasing, cyanide contents were decreasing when the two cassava samples were dried 45, 60 and 75 °C . When air–drying of the cassava chips reached 5 h, cyanide contents of TME 1 chips dried at 45, 60 and 75 °C reduced significantly. Also, from the air-drying of high cyanide cassava chips (91/02324), maximum cyanide removal occurred at 75 °C as chips collected at 300minutes contained 14.28 mg HCN/100g.

The kinetics of cyanide destruction during dehydration was obtained from the slopes of ln ($C/C_o$) against drying time at constant temperature and the plots for both varieties of cassava followed first-order reaction kinetics (Figures 2 and 3 respectively). The effect of temperature on the rate constants describing the loss of cyanide due to drying is illustrated in Figure 4. The data indicated that the rate constant followed Arrhenius relationship. The activation energy values for the cyanide destruction were determined to be 1.115 kJ/mol and 2.129 kJ/mol for TME 1 and 91/02324 varieties respectively.

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