Assessment of the Effects of Drying Techniques on Pasting properties of Cocoyam (Colocasia esculenta)

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Abstract

The analysis of the two drying techniques of the Taro cocoyam flour samples reveals which one has a better starch structure based on their pasting characteristics. These modifications impact the food product's final use, texture and digestibility. The sun-dried Taro cocoyam sample's final viscosity provides information about the quality of a specific starch-based flour, as it shows whether the flour can form a viscous paste after cooking and cooling, but can also be used as a good binder or to add consistency to food preparations.

Keyword: *Drying Techniques, Taro cocoyam, Pasting Properties*

Introduction

Cocoyam, however exceptionally nutritious, effectively break down because of the great dampness content they contain which inclines towards the development and exercises of miniature organic entities. Drying is one of the approaches to lessening the dampness content and thus expanding the time span of usability. In spite of the way that Nigeria is one of the biggest producers of cocoyam, there is deficient information on the warm and designing properties of the drying of these yields. The ramifications of this is that they have stayed unexploited and has restricted data that in any case would have been useful in planning modern dryers. Subsequently, this exploration work centers around assurance of the impact of drying techniques on the pasting properties of cocoyam flour samples.

Materials and Methods

Taro cocoyam (Colocasia esculenta) cultivar was harvested early February, 2023 at physiological maturity stage of seven months and two weeks of planting, the Taro cocoyam samples were sourced from Enugu State Agricultural Development Programme Office in Enugu State, Nigeria. The obtained samples were immediately transported and stored in temperature and relative humidity rate of 28°C ± 3 °C and 82 ± 5% respectively.

The cocoyam samples of cultivar (1 kg) were sorted, washed with potable water to remove adhering soil, and peeled manually with stainless steel knife. The peeled root crops were washed with portable water and sliced into 10 mm thickness and soaked into 0.02% solution of sodium metabisulphite for 30 min to prevent oxidation browning. The sliced samples were divided into two equal batches with the first batch sun dried while the second batch were oven dried using Multipurpose oven (Model N0: MCQTR54) at 70^0C for 60 minutes internal until constant drying rates are attained. The dried cocoyam samples were then milled into flour using hammer mill, sieved through a standard laboratory sieve of 500-micron meter aperture to produce uniform particle size flour, packaged in polythene bags, sealed and then stored in air tight containers with appropriate label (A & B) and then carried to the laboratory where the samples were investigated. The sample preparation stages are shown in figure 1.

Figure 1: Pictorial description of processing stages of cocoyam flour

Pasting Properties determination: The pasting characteristics of starch and starch products containing starch are investigated using a Rapid Visco Analyzer (Model RVA-4; New Port Scientific Pty. Ltd, Warrie wood, Australia) as described by Obinna-Echem et al., (2019).

5 g of the flour samples were weighed into a dried empty canister; 25 ml of distilled water was dispensed into the canister containing the sample. The mixture was thoroughly stirred and the canister was fitted into the RVA following the manufacturer's instructions. Measurement cycle was initiated: heating from 50 to 90^{o}C with a holding time of 2 min followed by cooling to 50^{o}C with 2 min holding time. The rate of heating and cooling were at a constant rate of 11.25^{o}C min-1. The pasting parameters: peak viscosity, trough, final viscosity, breakdown and setback viscosities (RVU), peak time (min) and peak temperature (°C) were read from the computer with the aid of Thermo cline for windows software.

Results and Discussion

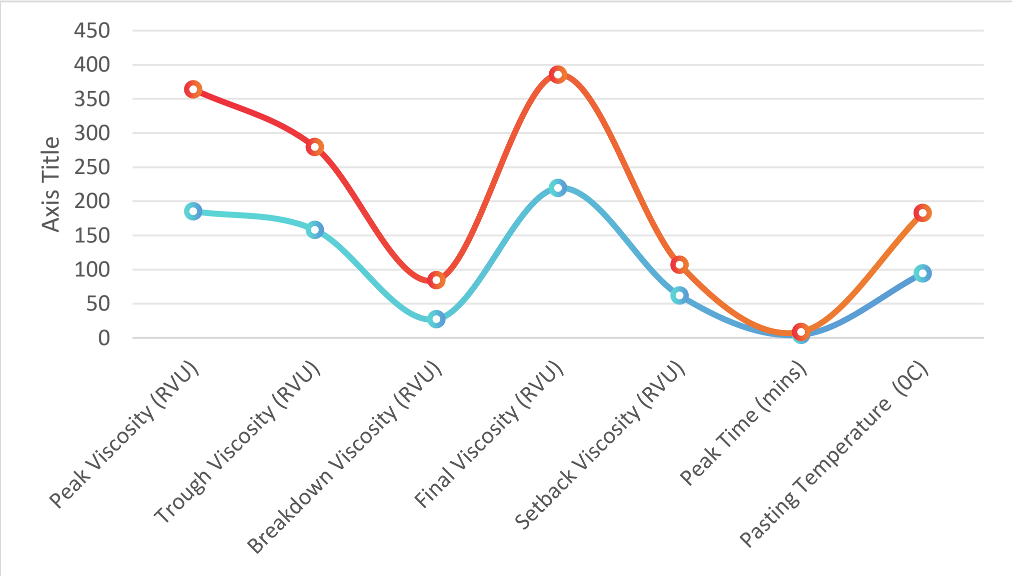
The results obtained from determination of the effect of drying techniques on the Pasting properties of cocoyam flour is presented in Table 1

Table 1. Pasting properties of cocoyam flour Taro variety

Parameters	**A**	**B**
Peak Viscosity (RVU)	185.42	178.58
Trough Viscosity (RVU)	158.13	121.30
Breakdown Viscosity (RVU)	27.29	57.28

Final Viscosity (RVU)	219.60	166.02
Setback Viscosity (RVU)	61.90	45.15
Peak Time (mins)	4.644	4.244
Pasting Temperature (^{0}C)	94.65	88.30

A=Taro sun-dried, B= Taro oven-dried



The graphical representation of Pasting properties of cocoyam flour Taro variety

Discussions

Peak viscosity is the maximum viscosity developed during or soon after the heating portion. It is an index of the ability of starch-based foods to swell freely before their physical breakdown (Ide et al., 2019, Adebowale et al., 2008 and Sanni et al., 2006). The peak viscosity in this research study revealed 185.42 RVU in sun dried and 178.58 RVU oven dried Taro cocoyam samples. The variation could be attributed to the higher damage caused to starch during the dry grinding process (Iwe et al., 2016). High peak viscosity also reflects fragility of the swollen granules which first swell and then breaks down under the continuous stirrng of the Rapid Visco Analyzer (Iwe et al., 2016).

Trough viscosity is the minimum viscosity value in the constant temperature phase of the Rapid Visco Analyzer pasting profile. In simple terms, trough viscosity is the point at which the viscosity reaches its minimum during either heating or cooling processes (Iwe et al., 2016). It measures the ability of the paste to withstand breakdown during cooling (Ide et al., 2019). It was observed that sun dried Taro flour sample recorded 158.13 RVU and oven dried 121.30 RVU The high trough viscosity indicates the tendency of cocoyam flour sample to breakdown during cooking,

The breakdown viscosity is an index of the stability of the starch and a measure of the ease with which the swollen granules can be disintegrated (Ide et al., 2019, Iwe et al., 2016 and Kaur et al., 2006). The oven dried cocoyam flour sample revealed the highest value (57.28

RVU) of break down viscosity while the sun dried indicated 27.29 RVU. According to Iwe et al. (2016), Ide et al. (2019) and Adebowale et al. (2005) the higher the breakdown viscosity, the lower the ability of the flour to withstand heating and shear stress during cooking.

Final viscosity is commonly used to define the quality of a particular starch-based flour since it indicates the ability of the flour to form a viscous paste after cooking and cooling (Ide et al., 2019 and Iwe et al., 2016). It also gives a measure of the resistance of the paste to shear force during stirring (Adebowale et al., 2005 and Adebowale et al., 2008). The final viscosity of analyzed cocoyam flour sample indicated 219.60 RVU in sun dried and 166.02 RVU in the oven dried samples. The variations in the final viscosity might be due to the simple kinetic effect of cooling on viscosity and the reassociation of starch molecules in the flour samples.This may be attributed to the hydrogen bonding during cooling and the high amylose content of the cocoyam flour or due to the variation in amylose molecules and its amount (Ide et al., 2022, Duyi et al., 2015 and Ding et al., 2015).

Setback viscosity indicates the tendency of starch granules to retrograde during cooling (Ide et al., 2019 and Iwe et al., 2016). It was observed that sun dried sample had highest value (61.90 RVU) while the oven dried indicated 45.15 RVU. According to Adebowale et al., (2008), the higher the setback viscosity, the lower the retrogradation of the flour paste during cooling and the lower the staling rate of the products made from the flour. Setback viscosity has been correlated with the texture of various end products. High setback viscosity is also an indication of the amount of swelling power of the cocoyam flour (Jennifer and Les, 2004).

Peak time viscosity which measures the cooking time of the cocoyam flour samples recorded 4.644 mins for sun dried sample and 4.244 mins oven dried sample. Lower values of peak time indicate the minimum temperature required to cook the flour. These findings were in agreement with what Adebowale et al., (2008) and Chinma et al. (2007) reported on yam–breadfruit composite flour and germinated tigernut flour, respectively.

Pasting temperature is one of the properties which provide an indication of the minimum temperature required for sample cooking, energy costs involved and other components stability. The pasting temperature of the analyzed cocoyam flour sample indicated 94.650 (^{0}C) in sun dried and 88.30 (^{0}C) in the oven dried samples. These variation in pasting temperatures of tested cocoyam samples could be attributed to the buffering effect of fat on starch which interferes with the gelatinization process (Ide et al., 2019 and Iwe et al., 2016). A higher pasting temperature indicates high water-binding capacity, higher gelatinization tendency and lower swelling property of starch-based flour due to high degree of associative forces between starch granules (Adebowale et al., 2008). .

Conclusion

The pasting properties of a food refer to the changes that occur in the food as a result of application of heat in the presence of water. These changes affect texture, digestibility and end use of the food product. The result of final viscosity of the sun dried Taro cocoyam sample offers the product the quality of a particular starch-based flour since it indicates the ability of the flour to form a viscous paste after cooking and cooling however, serve as a good binder or provide consistency in food preparations.

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