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Alternative method of reducing sugars determination in some selected fizzy drinks and fruits by chromic acid reagent

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Abstract

Chromic acid reagent as an alternative colorimetric method for the quantitative determination of reducing sugars and ascorbic acid in some selected fizzy drinks: Seven Up, Limca, Mirinda, Cocoa-Cola, Fanta, Pepsi Cola, Maltina, Guinness Malt, Hi-Malt and Maltonic) and fruits: pineapple (Ananas cosmoses), sweet orange (Cimifi sinensis), grape fruit (Dints paradise) and tangerine (Citrus reticulate) has been studied. Chromic method involves sugar solution of about 1% concentration. treated with an equal volume of concentrated nitric acid and a few drops of a 5% solution of potassium dichromate was added, a blue colour develops in less than a minute in the cold and the absorbance taken in a Spectronic 20D Spectrophotometer at 560 um. Results obtained from the simple chromic acid as test method compares well with those obtained from the titrimetric methods of Association of Official Analytical Chemists (AOAC, 2012) and Pearson (1991) as control, with negligible variations. Apart from being a very powerful oxidizing agent, its reaction with monosaccharide, disaccharides and ascorbic acid are less-time consuming, showed distinct colour development and its easy preparation, made chromic acid reagent a faster, better and suitable alternative method for the quantitative determination of reducing sugars and ascorbic acid in routine analyses of foods.

Keywords: reducing sugar, ascorbic acid, chromic reagent.
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Introduction

Quantitative determination of reducing sugars in foods can be carried out in several ways depending on their ease of handling and other factors which may influence the method of choice for research purpose and routine analyses. Such methods like the colorimetric (Sung, *et. al*, 2008; Christopher, *et. al*, 2009; Kristine Meile, 2014), the copper sulphate-arsenomolybdate reagent (Chitoshi and Yoshiaki 1980; Robert 2002), the photometric (Sreekanth and Prabhashini 2010), the enzymatic method (Flávia, *et al* .2013) and the chromatographic (Hasim, *et. al*, 2009; Ruiz-Matutea, *et. al*, 2011; Rodrigo, *et. al*, 2012) have been reported. Determinations of sugars from biological fluids by conventional means such as chromatographic methods are very invaluable (Adams, *et. al*, 1999, Robert, *et. al*, 2011; Erica, 2017)

Other methods such as colorimetric (Sung, *et. al*, 2008; Christopher, *et. al*, 2009; Kristine Meile, 2014), copper sulphate-arsenomolybdate reagent (Yijing and Amy, 2018), photometric (Paulo, *et. al*, 2018), the enzymatic method (Alexander, *et. al*, 2011) and the chromatographic (Hasim, *et. al*, 2009; Ruiz-Matutea, *et. al*, 2011; Rodrigo, *et. al*, 2012) have been reported. The determination of sugars by conventional means such as chromatographic methods (Adams, *et. al*, 1999) and methods (Robert, *et. al*, 2011; Erica, 2017) are very invaluable for the estimation of biological fluids.

Determination of reducing sugars as their trimethylsily (TMS) derivative is well documented and appears to be ideally suited for routine analysis (Robert, 2011).

While solutions of chromic acid which are readily reduced by compound of the alcohol type, the scope and conditions of the reactions were limited in the literature. The present study, therefore hope to investigate the use of chromic acid reagent as alternative method for the quantitative determination of glucose, fructose and ascorbic acid in Nigeria beverages.

Materials and Methods:

Materials

Analytical grades of nitric acid, potassium dichromate, glucose, fructose, ascorbic acid, activated charcoal, hydrochloric acid were obtained from the Sigma Aldrich (Gillingham Dorset, UK), and Spectronic 20D Spectrophotometer from Bausch and Lomb, UK

Samples Collection:

Samples selected were Nigeria Fizzy Drinks: Seven Up, Limca, Mirinda, Cocoa-Cola, Fanki, Pepsi Cola, Maltina, Guinness Malt, Hi-Malt and Maltonic), and Nigeria fruits: Pineapple (Ananas cosmoses), sweet orange (Cimifi sinensis), grape fruit (Dints paradise)

and tangerine (Citrus reticulate) were obtained at different locations Oja Oba market in Ilorin town, Kwara State.

Chromic Reagent Method:

1% of sugar concentration was treated with an equal volume of concentrated nitric acid, few drops of 5% solution of potassium dichromate were added and a blue colour developed in less than a minute in the cold.

Procedure:

5g of the potassium dichromate was put into 100ml flask containing 30% of HNO_3 acid solution, mixed and shaken to get 5% chromic acid reagent.

Preparation of standards:

Solutions of glucose and fructose (approx. 0.1% of each component) were prepared. A range of concentrations of the individual sugars from 0.01, 0.05, 0.1, 0.15 and 0.2% w/v in deionized water were prepared in conical flasks. 5ml of 5% chromic acid was added and allowed for 30 minutes. A blue colour developed and absorbance taken in Spectronic 20D Spectrophotometer at 560 nm. The blanks (without sugar solution) were also prepared.

Preparation of samples:

5g of activated charcoal was added to each (hydrolyzed with 5ml of 0.5M of HC1) measured solutions of soft, malt and fruit drinks. This was boiled for few minutes to eliminate air-bubbles in case of carbonated drinks and allowed for 30 minutes of decolourization. 5ml of 5% of chromic reagent was added to the decolorized filtrate and a blue colour developed, and the contents diluted to 100ml mark. The absorbance measured and the concentration estimated from the respective calibration curves.

Titrimetric Methods of AOAC (2012) and Pearson (1991) served as control methods as reported in the literature to compare suitability and reproducibility of chromic acid as a new, faster and better technique.

Results and Discussions:

Results from standard solutions:

Table 1 shows a range of concentrations of the individual sugar concentrations from 0.01 - 0.2% w/v in chromic acid were prepared for the calibration graphs. Absorbance was taken in Spectronic 20D Spectrophotometer at 560 nm. The coefficient of variation (R2) indicates the linearity of the calibration graphs used to derive concentration values and these are higher than 0.99 in glucose and fructose ($0.9534<r2<0.9998$).

The sugar contents of selected fizzy drinks

These were determined using the chromic reagent as test method and Titrimetric of AOAC (2012) and Pearson (1991) methods as control. In all the nine determinations, there were no significant variations in the profiles of the results of the different samples examined. Similarity of the results from the chromic reagent as test method with the other two titrimetric techniques as control indicated the suitability of the chromic reagent as alternative method of sugar determination as shown in Table 1.

Table 1: Reducing Sugar Contents in Fizzy Drinks using Chromic Reagent, AOAC and Pearson Methods (g/L)

Samples	Chromic Method	AOAC Method (2012)	Pearson Method (1991)	CV
Pepsi Cola	30.00	30.29	30.15	0.01
Coca Cola	36.00	36.00	36.00	0.01
Fanta	42.86	43.14	43.00	0.01
Seven Up	50.00	50.00	50.00	0.00
Limca	59.14	60.00	59.57	0.02
Mirinda	55.4	72.00	63.72	0.00
Maltina	58.79	60.00	59.40	0.02
Hi Malt	55.15	55.15	55.15	0.00
Guinness Malt	82.12	80.30	18.21	0.01

CV = Coefficient of variation

Sugar contents of fruit juices

Sugar contents of fruit juices and fizzy drinks showed a wider divergence; greater value in fruit juices is a welcome expectation for naturally fruit juices should contain more sugar than fizzy drinks because of additional sweeteners and presence of caffeine respectively. Values of malts drinks were indications of the types of grains and flavors used. Table 2 shows the sugar contents in fruit-juices using the same methods and the results were compared and also found to be close with the results obtained from the Titrimetric Methods of AOAC (2012) and Pearson (1991

Table 2: Reducing Sugar Contents in Fruit-juices using Chromic Reagent, AOAC and Pearson Methods (mg/l00g of samples).

Samples	Chromic Method	AOAC Method (2012)	Pearson Method (1991)	CV
Pineapple	47.70	47.83	47.77	0.01
Sweet orange	52.10	52.19	52.15	0.02
Grapefruit	52.43	52.46	52.43	0.01
Tangerine	7.51	7.54	7.53	0.01

CV = Coefficient of variation

Conclusion

The results from test chromic method compared well with the values from the titrimetric AOAC (2012) and Pearson Methods (1991) techniques, it also shows to be effective for sugar determinations owing for its ease of preparation and good colour development. With necessary refinement, it can be developed as an alternative faster and better method for sugar and ascorbic acid determinations.

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