COMPARATIVE STUDIES ON THE STABILITY OF VITAMIN C AND CAROTENOIDS OF SOME SLICED VEGETABLES AND FRUIT JUICES EXPOSED TO MICROWAVES AND γ-IRRADIATION

By

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ABSTRACT

The main purpose of this work was to maintain the integrity and contents of vitamin C and carotenoids. Carrots, sweet potatoes and mango were served as main sources of carotenoids while guava, lime and orange were considered as major reservoir for vitamin C. Two physical methods ,i.e., microwave and γ-irradiation treatments were applied in order to keep vitamin C and carotenoids of the aforementioned natural sources. The samples were exposed to γ-irradiation doses at ٠,٥, ١,٠, ١,٥, ٢,٠, ٢,٥ and ٣ KGy and microwave treatment for ١, ٢, ٣ and ٤ min emitted from an oven fixed at low power setting. The results indicate that vitamin C and carotenoids of the samples were variably degraded depending upon the conditions of treatments. Microwave treatment caused decreases in the levels of vitamin C of lime, orange and guava and the extent of reduction was dependent upon the exposure time. On the contrary, microwave treatment induced small reduction of vitamin C of mango juice, sliced sweet potato and carrots. γ-irradiation treatment induced gradual and significant decreases in the vitamin C levels of lime, orange and guava juices. In contrast, γ-irradiation caused an increase in the levels of carotenoids for mango juice, sliced carrots and sweet potatoes. In general, γ-irradiation treatment was better than exposure to microwaves for retention of vitamin C and carotenoids and hence extending the shelf life of the food sources under study. The mode of action of these physical methods on vitamin C and β-carotene content is discussed.

DEDICATION

I dedicate this work to whom my heart felt thanks; to my husband ***Ebrahem*** *and* ***my son Wagdy and my daughters Rahma and Ebtahal*** *for their patience and help, as well as to my parents and sisters and my mother in law for all the support they lovely offered along the period of my post graduation.*

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CONTENTS

LISTT OF TABLES

LISTT OF FIGURES

اسم الطالب:بثينة شعبان عبد الحكيم **الدرجة**: الماجستير

عنوان الرسالة: دراسة مقارنة لثبات فيتامين C والكاروتينات فى بعض شرائح الخضراوات وعصائر الفاكهة المعرضة للميكروويف وأشعة جاما

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المستخلص العربي

تهدف هذه الدراسة إلى تقدير كلا من فيتامين C فى عصائر الجوافه والليمون والبرتقال والكاروتينات فى شرائح الجزر و شرائح البطاطا و عصير المانجو. تم إستخدام طريقتان طبيعيتان وهما الميكروويف وأشعة جاما للحفاظ على فيتامين C و الكاروتينات فى العينات سالفة الذكر وقد عرضت العينات لجرعات مختلفة من أشعة جاما وهى ٠,٥ ، ١ ، ١,٥ ، ٢، ٢,٥ ، ٣ كيلوجراي ، بينما عرضت فى فرن الميكروويف لمدد مختلفة وهى ١ ، ٢ ، ٣ ، ٤ دقائق على مستوى طاقة منخفض.

ودلت النتائج على حدوث تغيرات فى كميات فيتامينC والكاروتينات باستخدام الطريقتين سالفتى الذكر وهذا التغير يعتمد على ظروف كل معاملة وبصفة عامة تبين أن طريقة أشعة جاما كانت أفضل للحفاظ على مستويات فيتامين C والكاروتينات مقارنة بطريقة الميكروويف.

دراسة مقارنة لثبات فيتامين C والكاروتينات فى بعض شرائح الخضراوات وعصائر الفاكهة المعرضة للميكروويف وأشعة جاما

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دراسة مقارنة لثبات فيتامين C والكاروتينات فى بعض شرائح الخضراوات وعصائر الفاكهة المعرضة للميكروويف وأشعة جاما

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INTRODUCTION

The yellow, orange and red colour of many fruits and vegetables is due to the presence of different carotenoids. Green vegetables also contain carotenoids, but here the green chlorophylls mask the colour of the carotenoids. Some carotenoids have provitamin A activity, such as β-caronten, α-cryptoxanthin (Hart and Scott, ١٩٩٥ and Halliwell, ١٩٩٧).

Carotenoids have a range of important and well-documented biological activities. They are potent antioxidants and free-radical scavengers, and they modulate the pathogensis of cancers and coronary heart disease (Giovannucci, ١٩٩٩; Kritchevsky, ١٩٩٩ and Grassmann *et al.*, ٢٠٠٢).

Dietary caroteniods such as lycopene and β-carotene have emerged as potentially beneficial phytochemicals in the light of epidemiological research findings which link the consumption of food products rich in these carotenoids to the reduction in risk of developing certain types of cancer (Van poppel, ١٩٩٣; Steinmetz and Potter, ١٩٩٦ and Giovannucci, ١٩٩٩). Among dietary carotenoids, various geometrical isomers either occur naturally or are formed during thermal processing of fruits and vegetables and food preparation (Chandler and Schwartz, ١٩٨٨ and Lessin *et al.*, ١٩٩٧). As the isomeric forms of dietary carotenoids may possess different biological properties, an

understanding of the various factors affecting the formation of geometrical isomers prior to consumption and following ingestion may provide insights into the potentially important association between structure and function. It is well known in the case of provitamin A carotenoids such as α-carotene and β-carotene, for example, that the cis isomeric forms are less efficiently converted to vitamin A than the all-trans counterparts (Zechmeister, ١٩٦٢). For the cartenoid lycopene, which has no provitamin A activity, the relative abundance of molecules in the linear all-trans configurations compared to those in the bent cis forms appears to be variable as a function of medium. The application of various industrial treatments can lead to the formation of cis isomers, which do not have the same vitamin activity as all-trans isomers.

Non-thermal treatment technologies can make a significant contribution to improving the vitamin A intake during the off season, because conventional thermal treatments lead to partial degradation of vitamins, especially carotenoids.

The demand for minimally processed food has increased in recent years, owing to its greater retention of flavor, colour, and nutritive value and consumer demand for safe but high-quality natural foods (with minimal or no chemical preservatives). Although conventional thermal processing ensures safety and extend the shelf life of foods, it often leads to detrimental changes in the sensory qualities of the product. Processed fruits and vegetables have been considered to have a lower nutritional value than their respective fresh commodities