EFFECT OF SALINE WATER AND YEAST ON THE COMPOSITION AND NUTRITION VALUE OF SOME SEED SPROUTS

By

ISLAM MOHAMED TORK GABER MOSTAFA
B.Sci. Agric.Fac. Agric., Cairo Univ., 2008
Master of Agric. Sci., Fac. Agric., Cairo Univ., 2014

A Thesis Submitted in Partial Fulfillment

Of

The Requirements for the Degree of

DOCTOR OF PHILOSOPHY
in
Agricultural Sciences
(Advanced Agricultural Systems for Arid Lands)

Arid Land Agricultural Graduated Studies and Research Institute
Faculty of Agriculture
Ain Shams University

2019

Approval Sheet

EFFECT OF SALINE WATER AND YEAST ON THE COMPOSITION AND NUTRITION VALUE OF SOME SEED SPROUTS

By

ISLAM MOHAMED TORK GABER MOSTAFA

B.Sci. Agric. Fac. Agric., Cairo Univ., 2008
Master of Sci., Fac. Agric., Cairo Univ., 2014

This thesis for Ph.D. Sci. degree has been approved by:

Dr. Shamel Ahmed Shanan **……...**
Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Al- Azhar University

Dr. Shawky Mahmoud Selim **……**
Prof. of Microbiology, Faculty of Agriculture, Ain Shams University

Dr. Ahmed Abdelwahab Abdelhafez **……...**
Prof. of Microbiology, Faculty of Agriculture, Ain Shams University

Dr. Mamdouh Mohamed Fawzy Abdallah **……...**
Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Ain Shams University

Date of Examination: 12 / 2/ 2019

EFFECT OF SALINE WATER AND YEAST ON THE COMPOSITION AND NUTRITION VALUE OF SOME SEED SPROUTS

By

ISLAM MOHAMED TORK GABER MOSTAFA

B.Sci. Agric., Fac. Agric., Cairo Univ., 2008
Master of Sci., Fac. Agric., Cairo Univ., 2014

Under the supervision of:

Dr. Mamdouh Mohamed Fawzy Abdllah

Prof. Emeritus of Vegetable Crops, Department of Horticulture, Faculty of Agriculture, Ain Shams University (principal supervisor)

Dr. Ahmed Abdelwahab Abdelhafez

Prof. of Microbiology, Department of Microbiology, Faculty of Agriculture, Ain Shams University

Dr. Fatma Ahmed Ali

Head Research of Pollution, Regional Center for Food and Feed, Agricultural Research Center

ABSTRACT

Islam Mohamed Tork Gaber. Effect of Saline Water and Natural Elicitors on the Composition and Nutritive Value of Some Seed Sprouts. Unpublished Ph.D. Thesis, Arid Land Agricultural Graduated Studies and Research Institute, Faculty of Agriculture, Ain Shams University, 2019.

Legumes and cruciferae are important constituent of daily diet in many countries, and to improve their nutritional quality, this study was set to use abiotic elicitor (sodium chloride (NaCl)) and biotic elicitor (Baker's yeast *Saccharomyces cerevisiae*) duirng germination process of radish (*Raphanus Sativus*) and cowpea (*Vigna unguiculata*) sprouts to improve their nutritional quality. Treated sprouts with the best characteristics were used to make Pizza (from radish sprout) and pies (from cowpea sprout) for enhancing the nutrition values of these food products.

Radish and cowpea sprouts characteristics showed that 2000 ppm was the best NaCl concentrations, for studying the effect of yeast, at 10g/L, as a biotic elicitor, on chemical composition and phytochemical contents on treatment: tap water (TW), TW + yeast, saline water (SW) and SW + yeast, and control was dry seed (DS).

For radish and cowpea experiment, results showed that all proximate analysis noticeably increased in all treatments compared to dry seed, especially protein in TW or SW amended with yeast, except carbohydrates in cowpea sprouts. Minerals (Ca, Fe, Mg, K, Na and Zn), amino acids and fatty acids contents increased in sprouts treated with yeast-amended saline water, compared to no-yeast treatments.

Phytochemical analysis in radish and cowpea sprouts showed that germination had positive effect to present some phytochemicals in sprouts, including flavonoids, phenolic compounds and sulfur compounds, which are known to enhance human health. Flavonoids were noticed to increase in yeast treatment with both tap and saline water.

Proximate analysis composition of mini pizza, made with radish sprouts flour showed that the highest results of protein, ash, total lipid and fiber content were recorded in mixture containing 10 % radish sprouts flour and 100% market flour (Control). Proximate analysis composition of pies made with cowpeas sprouts flour showed that the highest values of protein and ash were recorded in pie mix containing 10% cowpea sprouts flour and 100% market flour (Control) either with tap and slain water or with and without yeast.

Sensory evaluation of pizza and pies showed that 10% sprouts flour either with tap and slain water or with and without yeast were better than other samples made with 20% sprouts flour in odor and taste tests. Texture and color tests showed no significant differences between treatment samples compared to control sample.

This study, and similar ones, can be a good start towards development of innovative value-added food products with elicited phytochemicals which have beneficial effects on human's health.

Key words: Radish, Cowpea, Sprouts, Biotic elicitor, Abiotic elicitor, *Saccharomyces cerevisiae*, Baker's yeast.

ACKNOWLEDGRMRNT

First of all, I am praising **ALLAH**, beneficent, the merciful for his great gencrous and for guiding me to carry out this work..

Special thanks to **Prof.Dr.MamdouhMohamed FawzyAbdallah,** professor Emeritus of Vegetable, Horticulture Dept.,Faculty of Agriculture,AinShams University, for his supervision, reviewing the manuscript and fruitful discussion during this work. He is an excellent supervisor, he always kept eyes on the progress of my work,gave me stimulating suggestions and he was at all the time available when I need his help and advice. It a great honor to work under his supervision.

I am also grateful to **Prof. Dr. Ahmed Abdel-Wahab Abdel-Hafez**, Prof. of Microbiology, Department of Microbiology, Faculty of Agriculture, Ain Shams University for his supervision, encouragement and support me during this work.

I would like to thank **Prof. Dr. Fatma Ahmed Ali** Prof. in Regional Center for Food and Feed, Agricultural Research Center for his continuous advice during this work.

Many thanks **Prof. Dr. Mohamed Hassanein El-Gamal** Head Researches in Pollution. Regional Center for Food and Feed, ARC, for providing all the help to complete this study, and his much helpful advice, given freely at all times.

Many thanks **Dr. TahanyAbd-El Ghafar A.Aly.**Researcher in biochemistry. Regional Center for Food and Feed, ARC, for much her advice.

CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS

ARC	Agricultural Research Center
CDS	Cowpea dry seed
CTW	Cowpea with tap water
CTW+ Yeast	Cowpea with tap water and *Saccharomyces cerevisiae* yeast
CSW	Cowpea with slain water
CSW+ Yeast	Cowpea with slain water and *Saccharomyces cerevisiae* yeast
DS	Dry seed
G	Gram
LSD	Least significant difference
ml	Milliliter
NaCl	Sodium chloride
NIST	National institute of standard and technology
RCFF	Regional center for Food and Feed
RDS	Radish dry seed
RTW	Radish with tap water
RTW+ Yeast	Radish with tap water and *Saccharomyces cerevisiae* yeast
RSW	Radish with slain water
RSW+ Yeast	Radish with slain water and *Saccharomyces cerevisiae* yeast
R.T	Retention time
TW	Tap water
TW + yeast	Tap water and *Saccharomyces cerevisiae* yeast
SW	Slain water
SW+ yeast	Slain water and *Saccharomyces cerevisiae* yeast
Yeast	*Saccharomyces cerevisiae*
YPS	Yeast polysaccharide

INTRODUCTION

Demanding for food will continue to increase towards 2050, as a result of population growth. Increases in food production per hectare of land have not kept pace with increasing in population which leads to the global food crisis. The world food crisis resulted from several factors: competition over cropland between biofuels and human feed, low cereal stocks, high oil prices, speculation in food markets and weather events. Thus, improving agricultural productivity by some means can be a possible solution to this crisis **(Sarinont *et al*., 2014).**

One approach for this, is to develop appropriate nutrient-dense complementary foods which could be achieved by increasing nutritional values of certain germinating seeds.

During seed germination, significant increases occur in the micro- and phytonutrient content of seeds, thus there is marked increase in the nutritive value of the seeds in sprouting. This ultimately signifies that sprouts should be considered a vital component of the diet and can be incorporated to improve agricultural productivity and easily used by malnutrition-low income families **(Wagner *et al*., 2013).**

Cruciferous sprouts are distinctive plant foods because of their rich composition in bioactive compounds compared to other plants. Germinating seeds may contain more than doubles of phytochemicals depending the species, cultivar, and environmental conditions. Seven or eight days old sprouts are of appropriate age for harvest allowing post-harvest handling and marketing of this material, maintaining contents of phytochemicals higher than other vegetables. Radish sprouts are very young plants that continue their highly metabolic activities after harvesting **(Baenas *et al*., 2014).**

Sprouting of legumes greatly influence nutritional quality by increasing bioavailability of nutrients as well as enhancing digestibility and utilization of nutrients **(Oboh *et al*., 2000)**. During sprouting

metabolic enzymes such as proteinases are activated which may lead to release of some amino acids and peptides and synthesis or utilization of these may form new proteins. As a consequence, nutritional quality of proteins may be enhanced by sprouting in legumes **(Gulewicz *et al*., 2008)**. Increased utilization of legumes will depend upon development of appropriate technologies to produce food products with enhanced nutritional quality **(Prinyawiwatkul *et al*., 1996)**. Sprouting of legumes enhances the bioavailability and digestibility of nutrients and therefore plays an important role in human nutrition. As a legume, cowpea **(***Vigna unguiculata***)**, is an important arid legume with a good source of energy, protein, vitamins, minerals and dietary fiber (**Devi *et al*, 2015**).

Many researches have been focused on developing efficient strategy for enhancing production of useful metabolites in food plants without gene modification or breeding. As the biosynthesis of several secondary metabolites in plants is usually a defense response of plants to biotic and abiotic stresses, their performance can be effectively stimulated by biotic and abiotic elicitors. Thus, elicitation can be an effective strategy for improving bioactive secondary metabolite production in plant tissue. Yeast polysaccharide (YPS) is an efficient biotic elicitor for stimulating secondary metabolite production in plant cell, where production of many valuable bioactive compounds has been successfully stimulated by YPS elicitors **(Zhao *et al*., 2012).**

Since the scientific information regarding the effect of biotic and abiotic elicitors on bioactive chemical compounds is still limited, this study aims to elaborate deeply this area.

In this study, chemical and phytochemical analyses of radish and cowpea seeds and their germinated sprouts were determined as affected by abiotic elicitor (saline water by NaCl salt) and biotic elicitor (*Saccharomyces cerevisiae*).

Results of this study could help improve the nutritional value of plant foods using natural elicitors by making pies and mini pizza as a good sources of protein **Pasiakos *et al*., 2015**.