EFFECT OF GERMINATION METHODS ON SPROUT PRODUCTION AND ACTIVE INGREDIENT CONTENTS OF SOME CRUCIFEROUS CROPS

By

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B.Sc. Agric. Sc. (Horticulture), Ain Shams University, 2007

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ABSTRACT

Mona Yahia Ahmed: Effect of Germination Methods on Sprouts Production and Active Ingredient Contents of some Cruciferous Crops. Unpublished M.Sc. Thesis, Department of Horticulture Faculty of Agriculture, Ain Shams University, 2014.

The effect of four seeding media (clay with vermiculate and adding 10% compost, rice straw, sponge and paper kitchen towels), four seeding densities (50%, 37.5%, 25% and 12.5%) and three sprouting time (7, 9 and 11 days) on radish, rocket and turnip sprouts characters and yield were studied. The ideal medium was clay with vermiculate and adding 10% compost for rocket and turnip, while rice straw for radish. The highest sprout yield per unit volume of seeds (g) was obtained using seeding density of 5.60 g, 2.1 g and 2.78 g/100 cm2 of radish, rocket and turnip respectively and harvest at 11, 9 and 9 days old respectively. Compared to indoor production, the open field sprout yield (g/g of seeds) increased significantly and sprout characters improved especially under shading condition. In addition, the open field sprout production brought marked increase in vitamin A and C especially with using mixed soil. Data was more pronounce with radish sprouts. However, vitamin E recorded lowest production in open field.

Concerning sprout mineral content, the open field sprouts provided marked increase in K and Ca. A 100g of edible portion of radish, rocket and turnip sprouts provide human (male and female, respectively) bodies with range of 220 – 612% and 283 – 787% of vitamin A and 14 – 80% and 17 – 96% of vitamin C and 14 – 75% and 6 – 33% of Fe.

Key Words:

Sprouts, Vitamin A, Vitamin C, Vitamin E, Minerals, Radish, Rocket, Turnip, Shading.

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1. INTRODUCTION

Seed germination and production of sprouts is an old habit that was adopted thousands of year's age by the ancient Egyptians **(Abdallah, 2008).** Sprouts are one of the most complete and nutritionally beneficial of all foods. Their nutritional value was discovered by the Chinese thousands of years ago. Recently, in the USA, numerous scientific studies suggest the importance of sprouts in a healthy diet.

Sprout seeds are an alternative source of food that can be adapted to the fast life conditions of the developed countries. Its practicality, both because of its obtainment and consumption form, is one of the attractive properties and has existed as an indispensable kind of food in the kitchens of vegetarians. Sprout seeds can also be consumed as diet nourishment because of containing little amount of calorie. Despite less amount of calorie, they can be called as a store of proteins and vitamins.

Seed sprouting is the practice of soaking, draining and leaving seeds until they germinate and begin to sprout. It has been identified as an inexpensive and effective technology for improving the nutritional quality of seeds. As water is introduced, enzyme inhibitors are disabled and the seed explodes to life **(Frias *et al*., 1995; Bau *et al*., 1997 and Schulze *et al*., 1997).**Germination is also known to improve the vitamins and minerals content **(Henry and Massey, 2001).**

Eating the fresh sprouts is the best way of gaining all of the health benefits claimed for cruciferous sprouts because only minor losses in health-promoting components are likely to occur **(Martinez-Villaluenga *et al*., 2008).**

According to **Chavan and Kadam (1989)** most reports agree that sprouting treatment of cereal grains generally improves their vitamin value. Certain vitamins such as α-tocopherol (vitamin E) and β-carotene (vitamin A precursor) are produced during the growth process vitamin E content increased from 7.4 mg/kg DM in grain to 62.4 mg in 6 day sprout sample and Beta-carotene from 4.1 mg to 42.7 mg in 6 day sprout sample

Cuddeford (1989). During germination in the dark, the activity of vitamin E in sprouts of radish and turnips was higher when compared to that of the respective sprouts germinated under light conditions **(Zielinski and Kozlowska, 2003).** Germination causes increases in ascorbic acid content from 4 to 20 fold (**Vanderstoep, 1981; Chen *et al.*, 1975; El-Adawy, 2002 and Mao-Jun *et al*., 2005)**.

Vitamin C was not detected in some row cruciferous seeds although sprouting increases its content during 5 days of germination **(Mao-Jun *et al*., 2005; Zielinski *et al*., 2007 and Perez-Balibrea *et al*., 2008)**.

Rocket and radish sprouts recorded high Fe and K as compared with child plants and mature radish leaves whether on dry or fresh weight basis **(Ibrahim, 2010)**.

Zielinski *et al*., (2006) reported that the levels of Ca and Mg were increased after fourth day of germinated turnips. Fe content dropped after 1 day of germination and from there onward it started to increase gradually and 18% retention was observed in 7 day germinated seeds.

A 100 gram portion cruciferous sprouts is able to cover the Recommended Dietary Intake for vitamins E,A and C in the range of 1.8 - 21.6% , 90 - 277.8% and 35.4 - 83.3% for men ,respectively and 1.8 - 29.5% , 115.7 - 367.1% and 42.5 - 100% for women ,respectively and for K , Fe , Ca and Mg in the range of 0.71 - 11.1% ,18.12 – 233.8% , 0.48 – 18.9% and 1.45 – 8.1% for men , respectively and 0.71 – 11.1% ,8.05 – 103.9%, 0.48 – 18.9% and 1.87 – 10.4% for women , respectively (**Zielinski and Kozlowska,2003; Anwar, 2009 and Ibrahim, 2010**).

Since, the quality and quantity of bioactive compounds are important when the cruciferous sprouts are considered as a new functional food, the present study was undertaken to investigate the effect of media, seeding density and sprouting time on sprout yield and characters. Also, growing location effects on content of vitamins (A, C and E) and minerals (Ca, Fe, K, S and Mg) in sprouts.

2. REVIEW OF LITERATURE

In order to have a wide view on the review of this study, the collected literature will be review under the following items:

2.1 Seed sprouting and sprout production
2.2 Chemical composition of sprouts

2.1. Seed sprouting and sprout production

Sprout seeds as a human food has a long history. Ancient egyptians and Chinese thousands of years ago, consumed sprouts as a healthy food **Abdallah (2008)**. Also, **Taraseviciene *et al*.,(2009)** showed that seeds germination to obtain sprouts is a technological method used for many years. Recently, sprouts are especially popular in the kitchens of Far East **(Liebster, 1991)**.

Sprouts are considering a predigested food with higher biological efficiency values and lower levels of antiphysiological factors than raw or cooked seeds **(Balasaraswathi and Sadasivam, 1997 and Chung *et al*., 1989)**. Hence, numerous studies have demonstrated that sprouts are one of the most complete and nutritious foods **(Bau *et al*., 1997; Kaur and Kawatra, 2002; and Yang *et al*., 2001)**.

Germination is an inexpensive and simple method of improving nutritive value, and several studies have reported higher levels of nutrients and lower values of antinutrients in germinated seeds and compared to the ungerminated originals **(Raman, 1984; Honke *et al*., 1998; Frias *et al*., 1995 and Vidal Valverde *et al*., 2002**

Seed sprouting is the practice of soaking, draining and leaving seeds until they germinate and begin to sprout.

Presoaking seeds in water can be use to speed up germination, and has been used to accelerate germination of several species. The basis for the acceleration is likely that hydrolytic process begins during presoaking, and the resulting simple sugars that are release can be utilize for synthesis

immediately upon germination. That membrane repair may occur by enzymes activated during the hydration process. Conversely, soaking seeds may be determined to germination capacity and should not be using unless definitely needed. Prolonged soaking has found to cause injury to seeds of many species **(Copeland and McDonald, 2001)**.

The most rapid water uptake occurred during the first 3 hr. of soaking, while water imbibe rate began leveling off after 9 hr. of hydration. Pea seeds soaked for 6 and 9 hr. were similar in percent germination, both treatments produced better sprout quality than soaked for 3 or 12 hr. In subsequent trials, it was find that 6-9 hr. soaking was also satisfactory for lentils. However, faba beans required 18 hr. of soaking time **(Hsu *et al.*, 1980)**.

Some authors reported that germinating seeds were washed or sprinkled once a day (**El-Mahdy and El-Sebaiy., 1983 and Dagnia *et al.*, 1992)**. While other authors reported that germinating seeds were rinsed twice a day **(Harrison and Vanderstoep, 1984 and Egli *et al.*, 2002)** or sprayed twice daily **(Chang and Harrold, 1988 and Shimelis and Rakshit, 2007)**.on the other hand, some seeds like mustard is mucilaginous and gets slippery when soaked in water **(Wallis, 1985 and Anwar, 2009)**

Germination starts with the uptake of water (imbibition) by the quiescent dry seed and terminates with the emergence of the embryonic axis, usually the radical. It is a time of intense metabolic activity, involving subcellular structural changes, respiration, macromolecular syntheses and finally cell elongation. Establishment of the seedling occurs following germination and its growth is initially supported by metabolites produced by the hydrolysis and conversion of the mayor stored reserves proteins, carbohydrates and lipids **(Zielinski *et al.*, 2006).**

Searching of new sources of functional food, especial attention has paid to sprouts from rapeseeds that have increasingly used in human diets (**Frias *et al.*, 2005**). Sprouted radish seedling at the cotyledon stage

used as garnish and in salad in many countries (**Abdallah, 2008; Ibrahim, 2010 and Rubatzky and Yamagucbi, 1997**).

Moreover, **Troszynska *et al.*, 2002** reported that consumption of cruciferous vegetable sprouts may be one of the most powerful. Recently, cruciferous sprouts were evaluated for their sensory quality in terms of consumers' acceptance.

Radish and rocket fresh green sprouts have a slightly salty taste, hot and rich in enzymes, low in fats, highly nutritious, rich in energy and essential vitamins and amino acids (**Cairney, 2005 and Ibrahim, 2010**). Also radish sprouts were shown to have the highest hydroxyl radical scavenging potency among the 11 kinds of commonly available vegetables **(Takaya *et al.*, 2003).**

Epidemiological data showed that a diet rich in cruciferous vegetables can reduce the risk from a number of cancer and that the risk can be significantly reduced by intake as little as 10 grams per day (**Graham, 1983 and Kohlmeier and Su, 1997**).

2.1.1. Growing media

Many researchers used soil, sand or soilless potting mixes in the tray for green sprout production **(Cairney, 1997; Cantisan *et al.*, 1999; Sivakumar *et al.*, 2007 and Abdallah, 2008)**.

Methods reported in the literature for sprouting of seeds have used paper towels or sponge as a medium **(Anwar, 2009; Abdallah, 2008 and Frias *et al.*, 2007)**. With the use of sponges the moisture content could be regulated, less washing was required and no washing during the entire process was required for peas and beans **(Fordham *et al.*, 1975 and Abdallah, 2008)**.

Anwar, 2009 and Ibrahim, 2010 found that clay with vermiculate (1:1 v: v) + 10% compost medium had the longest length and heavier weight of sunflower sprout.