EFFECT OF STORAGE PERIOD OF SOME SEED ON PRODUCTION AND QUALITY OF SEED SPROUTS IN SALINE WATER

By

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ABSTRACT

Basma Mohamed Mahmoud. Effect of Storage Period of some Seed on Production and Quality of Seed Sprouts in Saline Water Unpublished M.Sc. Thesis, Arid Land Agricultural Graduated Studies and Research Institute (Advanced Agricultural Systems for Arid Lands). Faculty of Agriculture, Ain-Shams University, 2018.

One day old wheat grain and three days fenugreek sprouts were used to study the effect of using saline water for sprouting on sprout characters, and changes of some chemical compounds after 2 years wheat grain storage of Gemmeiza 11 cultivar and fenugreek balady cultivar seeds. Sprout characters showed no significant different in storage grain sprouts weight at all NaCl concentration while increased in fresh grains sprouts with increasing NaCl concentration. Sprouts chemical components as affected by storage revealed that storage Gemmiza II had the highest crude protein and the lowest carbohydrate content compared with dry fresh seeds. Non storage grains also had higher protein and lowest carbohydrate and energy content compare with dry fresh grains. The results of phytochemical analysis showed that wheat fresh grain and fenugreek seed sprouts increase phytochemical compounds and recorded the higher values when using saline water (37 and 46 compounds respectively) followed by using tap water (33 and 45 compounds respectively) compared with dry fresh grains and seeds (30 and 38 compounds). Saline water also enhanced the number of phytochemical compounds in two year storage wheat grain sprouts (31 compounds vs. 28 compounds for tap water) while decreased compounds in fenugreek seed sprouts (43 compounds vs. 45 compounds for tap water). Moreover, storage grains decreased the number of identified compounds during sprouting. It can be recommended that wheat grain and fenugreek seed sprouting is a procedure that has been developed to significantly increase the bioavailability of phytonutrients and phytochemical to ensure the nutritional security of population for Egypt.

Keywords: Storage wheat grain; Sprouting, Saline water, Proximate analysis, Phytochemicals.

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INTRODUCTION

Seeds commence deterioration upon separation from the mother plant. However, seed deterioration occurs during storage, leading to reduction of germination percent and decreasing seedling growth rate **(Roberts 1983).** Seed deterioration is greater under improper storage conditions, such as higher seed moisture and temperatures as in open storage.

Wheat is (*Triticum sativum* L.) an important crop for the Egyptian economy. During the past few decades research publications have encouraged increased consumption of whole grain food products due to their positive health benefits **(Shahidi and Chandrasekara, 2013, Chanson-Ralle et al., 2014 and Luthria et al., 2015).** The phytochemicals found in whole grains may be responsible for the health benefit of whole grains consumption as reported by **Okarter et al. (2010).**

Fenugreek *(Trigonella foenum graecum)* is a small seed. It is member of Fabbacea family, growing in different locations in the world. The major countries that produce the seed are: India, Turkey, Ethiopia and Egypt. The seed contains low concentration of some steroids. The seed of fenugreek was widely used in different countries around the world, it is even used medically or as human food, the uses of the seed for other purposes are still under search. Importance of the seed comes from its high content of protein and diosganin (diosganin is a sapogenin used in the manufacture of commercial steroids; **(Faliz and Hardman, 1968).** It is a good source of essential amino acid, especially: lysine, leucine and total aromatic amino acids equal in value with soybean. Minerals comprise high percentage in the seed, it is rich in Na, Ca, Cu, and Zn the seed is the richest of all vegetables in vitamin C **(El Mansour 1994 and Niknam et al., 2003).** Water and salt stress are the most important limiting factors in wheat productivity in semi-arid regions in the world. Most plants suffer after exposure to saline conditions and should decline

in growth. The deleterious effect of salinity was suggested as a result of water stress ion toxicities, ion imbalance or combination of all these factors **(Kurt et al., 1986). Seed** germination is one of the most critical periods for crops subjected to salinity. Salt stress has been shown to decrease the germination rate of some crops **(Ashraf, 1994 and Yildirim et al., 2002).**

Previous studies have reported the phytochemical content of whole wheat **(Adam et al., 2003; Moore et al., 2005; Mpofu et al. 2006 and Pellegrini et al., 2006).**

The phytochemicals found in whole grains may be responsible for the health benefit of whole grain consumption as reported by **Okarter et al. (2010).** Whole grain phytochemical include phenolics, compounds contains one or more aromatic rings or hydroxyl groups, carotenoids, vitamin E and others **(Adam and Liu, 2002 and Ibrahim, et al., 2017)**

Since the quality and quantity of bioactive compound are important when the sprout are considered as a new functional food. The present study was undertaken to investigate the effect of sprouting using saline water onstorage wheat grain and fenugreek seed sprout character, proximate composition and phytochemical compounds fraction.

REVIEW OF LITERATURE

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

I. Seeds and seed storage
II. Seed germination and sprout production
III. Effect of seed sprouting on sprout chemical composition
IV. Effect of salinity on sprout characters and chemical composition

I. Seeds and seed storage

Seed viability and vigor decreased with prolonging storage period. Electrical conductance of seed leachates also increased with storage under unfavorable conditions. Packaging container and storage duration significantly affected viability and seedling vigor **(Rao et al., 2006).** Seeds must be properly stored in order to maintain an acceptable level of germination and vigor until the time of planting. The storage period may vary from as little as 6 months, if the seeds are to be planted the next season, or longer if the seeds are to be carried over for one or more seasons. It short period and started to decline to a level that may make the seed unacceptable for planting purposes, **(El-Borai et al., 1993).** Seed of most species may be safely stored for several years by careful control of temperature and relative humidity. Although such conditions are of high cost for most agricultural seed lots, they may be extremely valuable for preserving germplasm and certain high value seed stocks. In some parts of the world, especially in the tropics conditioned storage is necessary in order to maintain high viability of some seeds from harvest to planting (**Hurrington, 1973).** Proper storage minimizes the rate of deterioration and prolongs the first phase, in which relatively little loss of viability occurs **(Anonymous, 1991).** Seed detraction increased and life span decreased as storage temperature and moisture content increased. The packaging methods and equipment used are dictated by the kind and the amount of seed to be packed, type of package, duration of storage,

temperature, relative humidity of the storage area, whereas the packing is for wholesale, retail or local use and geographical area where the package seeds will be stored, exhibited, or soils.

II. Seed germination and sprout production

Abdallah (2008) reported that seed germination and production of sprouts is an old habit that was adopted thousands of years ago by the ancient Egyptian. He also determined 24 hr. of sprouting to be the optimum period for seed grains **(Abdallah and Abo El-Naga, 2013).**

Sprouting induces biosynthesis of this vitamin considerably **(Sattar et al., 1995)**, thiamin and niacin are readily available through sprouts. Vitamin A content of seeds is improved considerably after sprouting.

Germination is a technological application widely used for its ability to decrease levels of antnutritional factors present in grains seeds and improve the concentration and availability of their nutrients **(Vidal-Valverde et al., 2002)**.

Today, research seems to be confirming that sprouts are the food and medicine of the future, as was food and medicine of the past. **(Penas et al., 2008 and Marton et al., 2010).**

Hence, germination of seeds is one of the best methods to be utilized in the improvement of the nutritional profile of the seed grains and which will be used for the development of various food products, and as in the present scenario people is more health conscious.

So, the germination of cereals and legumes important both from nutritional as well as functional point of view. Germination not only improves the bioavailability of the various minerals, vitamins and dietary fibers along with the nutritional profile of the seeds grains, but also reduces some anti-nutritional factors, which reflect the beauty of this method **(Warle et al., 2015).**

III. Effect of seed sprouting on sprout chemical composition

The normal seed contains materials, which it utilizes during the process of its germination. These substances are frequently found in the endosperm. Thus endosperm may contain variety of stored materials such as starch, oils, proteins etc. in some seeds, however, the reserve food materials is present in cotyledons. Seeds to be sown should contain all the desirable quality traits such as carbohydrates, proteins, lipids, minerals depending the crop species. The seeds are also the food for the human being and animals. The food reserves which are stored in the seeds for the initial growth of the plants; constitute a rich food elements **(Maiti et al., 2006).**

There are two main group of seeds used as food, one are cereals and the second are the legumes which supply proteins and some are rich in carbohydrates (i.e. beans, lentils, lupine and fenugreek ….etc.). However, other seeds supply high percentage of oils relatively with high protein content (sunflower, soy bean and mustard….etc.). Food legumes are important constituent of daily diet in many countries. They are a very good source of protein and carbohydrates; however, their protein digestibility is limited due to protein structure and also some antinutritional factors **(Blaszczak et al., 2007).** In order to improve the nutritional quality of legumes, use has often been made of germination procedure **(Frias et al., 1998).** Eating the sprouts is the best way for gaining all of the health benefits **(Martinez-Villaluenga et al., 2008).**

The improvement is usually a result of breakdown of complex macromolecules as protein and starch into smaller and more digestible molecules, while at the same time lowering the amounts of antinutritional factors **(Labaneiah and Luh, 1981 and Chang and Harrold, 1988).** Furthermore, this process could enhance the composition and content of bioactive compounds such as vitamins E and C **(Frias et al., 2005).**

Germination of seeds; however, appears to be a relatively simple non-chemical approach for decreasing antinutritional content. The process

of germination does not require intensive energy output and also yields natural products **(Mahajan and Dua, 1997).** Some of the reserve materials of the seeds are degraded and used partly for respiration and partly for synthesis of new cell constituents of the developing embryo during germination **(Vidal-Valverde et al., 2002).** Additional advantages of germination are reduction in cooking time and improvement of sensorial attributes of the product **(Vanderstoep, 1981).**

Compared to seeds, the sprouts have a higher quantity and quality of protein and more favorable amino acid composition **Urbano et al., 2005; Wang et al., 2005; Abdallah et al., 2009 and Ibrahim et al., 2017).**

The greatest increase during germination appears to be in glutamic and aspartic acids **(Palmer et al., 1973; Chen and Thacker, 1978; Hsu et al., 1980; Rozan et al., 2001 and Abdallah et al., 2009).**

Ijarotimi (2012) reported that proximate composition of germinated wheat flour were 13.23% moisture, 13.50% protein, 82.13% carbohydrates, 1.53% fat, 1.93% fiber, 0.97% ash and energy 396.17 Kcl.

Pandhre et al. (2011) found that the proximate composition of sprouted wheat grains were 11.4%, 0.95%, 11.69%, 1.36%, 72.29%, 54.48% and 4.38% for moisture, fat, protein, ash, carbohydrate, starch and total sugar, respectively.

Dawidziak (2014) showed the composition of Korweta variety of germinated wheat grains was as follows: 254.3 mg/100g total iron content, 13.92% crude protein, 1.79% fat, 59.6% starch, 3.41% fiber and 2.10% ash.

Khan (1999) showed that the proximate composition of sprouted barley grains on dry matter basis which were 9.5% moisture, 11.25% crude protein, 64.86% carbohydrates, 2.43% fat, 8.81% crude fiber, 3.15% ash and 19.52 gross energy Kj/g, while, Dung et al. (2010) found

that the composition of sprouted barley grains were 15.4% crude protein and 4.3% ash.

Youssef et al. (2013) determined the proximate composition of barley grains Giza 126 (hulled barley) and Giza 130 (hulled less barley). The proximate analysis of Giza 126 was 4.40% moisture, 9.67% crude protein, 3.90% crude fiber, 82.66% carbohydrates, 2.43% ash, 2.40% ether extract and energy 381.75 Kcal. On the other hand, the content of Giza 130 was 5.37% moisture, 13.08% crude protein, 4.37% crude fiber, 77.78% carbohydrates, 2.29% ash, 2.48% ether extract and energy 358.67 Kcal.

Warle et al. (2015) studied proximate analysis of germinated barley flour they were found that 11.2% moisture, 13.85% crude protein, 61.06% carbohydrates, 5.61% crude fiber, 5% fat and 1.39% ash, while, ungerminated barley flour were 9.6% moisture, 11.25% crude protein, 72.02% carbohydrates, 3.58% crude fiber, 7% fat and 1.59% ash.

Jood et al. (1986) referred to germination of some legumes for 24 hr. the losses in the amount of total sugars, reducing sugars and non-reducing sugars were higher than observed in seeds germinated for 48 hr. on further germination up to 96 hr. the content of these sugars increased, while starch content decreased and showed that germination of pulses for 24 hr. is a reasonably good treatment for reduction of flatus producing carbohydrates as well as avoiding excess losses of the available carbohydrates.

Manny and Shadaksharaswany (2005) reported that the crude fiber most likely from the bran of the whole wheat grain flour represent variable fraction of dietary fiber and includes mostly the lignin, cellulose, and hemicelluloses components .

Dietary fibers play a significant role in the prevention of several diseases **(Salvin, 2005 and Elleuch et al., 2011).**