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Production of Juice from Wheat Grass Powder

إنتاج عصير من مسحوق عشب القمح

**A Dissertation Submitted in partial Fulfillment For
The Requirements Of B.Sc (Honours) Degree in Food
Science and Technology**

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الآية

قال الله تعالى :

﴿وَقَالَ الْمَلِكُ إِنِّي أَرَى سَبْعَ بَقَرَاتٍ سِمَانٍ يَأْكُلُهُنَّ سَبْعٌ عِجَافٌ وَسَبْعَ سُنبُلَاتٍ خُضْرٍ
وَأُخَرَ يَابِسَاتٍ يَا أَيُّهَا الْمَلَأُ أَفْتُونِي فِي رُؤْيَايَ إِن كُنْتُمْ لِلرُّؤْيَا تَعْبُرُونَ﴾ (يوسف/43)

صدق الله العظيم

Dedication

To our parents,

Thanks for great support and continues car.

To our brothers,

We are really grateful for them, they are our inspiration and our soul mates.

To our teacher,

To all those who take the science of a mission to travel to cut through the path of knowledge and tarnished form.

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Abstract

The aim of the study was to highlight the health benefits of wheat grass juice and produce wheat grass powder for juice preparation. wheat grain Variety (Al-Neelain) was germinated for ten days, then the shoots were harvested and dried in oven at (55 °C) for 36 hours.

The result of chemical composition of wheat seeds showed that the Moisture Content was (13.65), protein (11.613), fat (1.370), Fiber (1.630) Carbohydrate (71.36) and ASH (0.373).

The result of chemical composition of wheat grass powder showed the Moisture Content of wheat grass powder was (6.463), Protein (25.40), Carbohydrate (51.617), Fiber (9.500), ASH (5.200) and Fat (1.740).

The result of sensory evaluation for (taste, color, flavor and overall acceptability) that carried out for wheat grass powder juice revealed that, the acceptance of panelists for this product over all acceptability (4.25±0.44). It can be concluded the wheat grass powder is recommended for healthy juice preparation.

ملخص الأطروحة

كان الهدف من الدراسة هو تسليط الضوء على الفوائد الصحية لعصير عشب القمح وإنتاج مسحوق عشب القمح لتحضير العصير .

نبتت صنف حبوب القمح (النيلين) لمدة عشرة أيام ،ثم حصدت البادرات وجففت في الفرن عند درجة حرارة (55 درجة مئوية) لمدة 36 ساعة .

أظهرت نتيجة التركيب الكيميائي لبذور القمح أن محتوى الرطوبة (13.65) والبروتين (11.613) والدهون (1.370) والألياف (1.630) كربوهيدرات (71.36) والرماد(0.373).

أظهرت نتيجة التركيب الكيميائي لمسحوق عشب القمح أن محتوى الرطوبة لمسحوق عشب القمح كان (6.463) ،بروتين (25.40) ،كربوهيدرات (51.617) ،ألياف (9.500)،الرماد (5.200) ودهن (1.740).

أظهرت نتيجة التقييم الحسي لـ (المذاق واللون والنكهة والقبول العام الذي تم إجراؤه لعصير مسحوق عشب القمح أن المنتج مقبول بتقييم كلي يبلغ (0.44 ± 4.25) ويمكن استنتاج أن مسحوق عشب القمح يمكن استخدامه لإعداد عصير صحي.

Table of Contents

	Title	Page No
-	الآية	I
-	Dedication	II
-	Acknowledgement	III
-	Abstract	IV
-	Arabic Abstract	V
-	Table of Contents	VI
-	List of Tables	IX
-	List of Plates	IX
CHAPTER ONE		
INTRODUCTION		
	Introduction	1-2
CHAPTER TOW		
LITERATURE REVIEW		
2.1	Cereals	3
2.2	General structure of grains	3
2.3	Importance of Cereals	4
2.4	Wheat	4
2.5	Classification of wheat	5
2.6	Nutrition Value of Wheat	5
2.7	Importance and use of wheat in the world	5
2.8	Importance, production and consumption of wheat in Sudan	6
2.9	Wheat composition	6
2.10	wheat grass	8
2.11	Nutritional analysis of wheatgrass	9
2.12	Medicinal uses of wheatgrass	9

2.13	Wheatgrass juice	10
2.14	Green Blood therapy	11
2.15	Wheat Grass and Its Nutritional Values	12
2.16	Method of preparation of Wheat Grass Powder by Different Drying Process	14
CHAPTER THREE		
MATERIALS AND METHODS		
3.1	Materials	15
3.2	Methods	15
3.2.1	Method of Germination	15
3.2.2	Shoot drying	16
3.2.3	Preparation of juice	16
3.3	Physiochemical Analysis	16
3.3.1	Moisture content	16
3.3.2	Total ash	17
3.3.3	Crude protein	18
3.3.4	Fat content	19
3.3.5	Crude fiber	20
3.3.6	Carbohydrate	20
3.4	Sensory Evaluation	21
CHAPTER FOUR		
RESULTS AND DISCUSSION		
4.1	Chemical composition of wheat grain	22
4.1.1	Moisture Content	22
4.1.2	Protein Content	22
4.1.3	FAT Content	22
4.1.4	FIBER Content	23
4.1.5	Carbohydrate Content	23
4.1.6	Ash Content	23
4.2	Chemical composition of wheat grass	24

	powder there blends were shown in table (3)	
4.2.1	Moisture Content	24
4.2.2	Protein Content	24
4.2.3	Carbohydrate Content	24
4.2.4	Crude fiber	24
4.2.5	Ash Content	24
4.2.6	Fat Content	25
4.3	Sensory Evaluation:	26
CHAPTER FIVE		
CONCLUSION AND RECOMMENDATIONS		
5.1	5.1 Conclusion	29
5.2	5.2 Recommendations:	29
-	References	30
-	Appendix	34

List of Tables

Table No	Title	Page No
Table 1	Wheat grass powder juice formula	16
Table 2	Chemical composition of wheat seeds.	23
Table 3	Chemical composition of wheat grass powder .	25
Table 4	Physical proprieties of wheat grass juice:	26
Table 5	the Sensory Evaluation of wheat grass powder juice.	27

List of Plates

Plate No	Title	Page No
Plate 1	Germination Seeds	34
Plate 2	Wheat Grass Shoots	35

Chapter one

Introduction

Cereal crops provide essential nutrients and energy in the everyday human diet through direct human consumption and also via meat production since they comprise a major livestock feed. According to the Food and Agriculture Organization, total crop production during 2016 reached 2577.85 million tons, whereas the production of coarse grains (cereal grains other than wheat and rice used primarily for animal feed or brewing) reached 1330.02 million tons (FAO-AMIS, 2017). The term “cereals” refers to members of the Gramineae family and determines nine species: wheat (*Triticum*), rye (*Secale*), barley (*Hordeum*), oat (*Avena*), rice (*Oryza*), millet (*Pennisetum*), corn (*Zea*), sorghum (*Sorghum*), and triticale, which is a hybrid of wheat and rye. The top cereals produced in the world in 2014, ranked on the basis of tonnage (in million tons), are corn (1253.6), rice (paddy, 949.7), wheat (854.9), barley (146.3), oat (23.2), and rye (15.8) (FAOSTAT, 2017).

Wheat (*triticum aestivum*) is the most widely cultivated crop on earth" contributing about a fifth of the total calories consumed by human.

Wheat grass is young grass" most often of the common Wheat plant *triticum aestivum* ("in 1930 Charles Scanlon") who has been called the (father of wheat grass) began documenting a wide range of its health benefits based on his observation in animal and human.

Wheat grass is freshly juiced or dried into powder for animal and human consumption- both the forms provide chlorophyll, amino acid, minerals, vitamins and enzymes. Many active compounds of wheat grass can cleanse the blood and neutralize and digest toxins in cells. Several reputed

companies involved in growing and selling of wheatgrass have published analyses of wheatgrass and they reported that wheatgrass is a rich source of chlorophyll, various minerals like iron, magnesium, calcium, phosphorus, antioxidants like beta carotene, insoluble dietary fibers while being low in fat content

In this study the health benefits of wheat grass powder and juice will be high light .

The Objectives:

The main objective of this study is to produce wheat grass powder for wheat grass juice preparation .

The Specific Objectives :

1. To produce wheatgrass powder.
2. to determine the chemical composition of wheatgrass powder
3. To produce juice from wheat grass powder.
4. To evaluated the physicochemical analysis of wheat grass juice .

CHAPTER TWO

Literature Review

2.1 Cereals:

Cereals can be defined as a grain or edible seed of the grass family, Gramineae (Bender and Bender, 1999). Cereals are grown for their highly nutritious edible seeds, which are often referred to as grains. Some cereals have been staple foods both directly for human consumption and indirectly via livestock feed since the beginning of civilization (BNF, 1994). Cereals are the most important sources of food (FAO, 2002), and cereal based foods are a major source of energy, protein, B vitamins and minerals for the world population. Generally, cereals are cheap to produce, are easily stored and transported, and do not deteriorate readily if kept dry.

2.2 General structure of grains :

Grains develop from flowers or florets and, although the structures of the various cereal grains are different, there are some typical features. The *Embryo* (or germ) is a thin-walled structure, containing the new plant. It is separated by the *scutellum* (which is involved in mobilization of food reserves of the grain during germination) from the main part of the grain, the *endosperm*. The endosperm consists of thin-walled cells, packed with starch grains. If the cereal grain germinates, the seedling uses the nutrients provided by the endosperm until the development of green leaves that allow photosynthesis to begin (FAO, 1991; Kent and Evers, 1994). The endosperm is surrounded by the *aleurone*, consisting of one or three cell layers (wheat, rye, oats, maize and sorghum have one; rice and barley three). The outer layers of the grain are the pericarp (derived from the ovary

of the flower) which surround the *seed coat*. The outer thick-walled structures form the bran.

2.3 Importance of Cereals:

The demand for cereals as food and feed is increasing due to population Explosion and short falls in cereal production In several developed countries. It is well established that the majority of the people in the developing countries depend mainly on cereal grains as their stable food due to limited income and high prices of animal foods .Cereals generally provide Almost 50% the total Caloric for the people of the world (Henery and Kettlewel, 1996).

2.4 Wheat:

A cereal grass of the Gramineae (Poaceae) family and of the genus *Triticum* and its edible grain, is the world's largest cereal-grass crop. It has been a food crop for mankind since the beginning of agriculture. The Middle East is probably the area of origin, and wheat apparently spread through out Europe not later than the Stone Age. Historians believe it has been growing since Paleolithic times and cultivated for at least 6,000 years. Its status as a staple is second only to rice. One reason for its popularity is that, unlike other cereals, wheat contains a high amount of gluten, the protein that provides the

elasticity necessary for excellent bread making. Although over 30,000varieties of wheat exist, the two major types are bread wheat and durum wheat. Global production of wheat is approximately 600 million tons; with international trade approximately 100 million tons annually. Wheat is Asia's second most important staple and has been growing much faster than rice .Wheat now provides one-fifth of total developing country food supply,

up from 15 % in the early 1970s. In 1992-94, developing countries accounted for 45 % of world wheat production (551 million tons) and 46 % of world wheat area (219 million ha).

2.5 Classification of wheat :

Classification of *Triticum aestivum*

Kingdom : Plantae

Division : Magnoliophyta

Class : Liliopsida

Order : Cyperales

Family : Gramineae

Genus : *Triticum*

Species : *aestivum*

2.6 Nutrition Value of Wheat:

Wheat and wheat foods are major source of nutrients for people in many regions of the world. Wheat is a source of carbohydrate, proteins, vitamins and minerals when consumed as a major component of the diet. Consist mainly of starch and significant proportion of many minerals and vitamin. Nutrients are generally found in the highest concentrations in the germ and in the aleurone cells surrounding the starchy endosperm. Significant quantities of minerals and vitamins are lost when whole wheat is milled to produce white endosperm flour because the outer layer of bran are removed along with aleurone cells and germ (FAO, 1970).

2.7 Importance and use of wheat in the world

Wheat (*Triticum spp*) continues to be one of the world most important grains,

especially as food , where the unique properties of its products can beutilized to advantage (Inglett,1974).

The cultivation of wheat, reach far back in history, and the crop was predominant in antiquity as a source of human food. Wheat is a major cereal produced, imported and exported, its most important use is in the manufacture of all breads, biscuits and pastry products.

2.8 Importance, production and consumption of wheat in Sudan

Wheat in Sudan is grown under irrigation during the dry and comparatively cool winter season which extends from November to February (Ishag and Ageeb,1991). Wheat production was confined to the northern Sudan along with the Nile bank ; the growing area extended southward to the warmercentral and Eastern Sudan (Ageeb, 1994).In term of cultivated area, in average, 96% of the area cultivated with wheat fell within the irrigated sector during the period between 2008 and 2013 andit recorded a high share of 98% during the 2014/2015 season (**Al-Feel** and**Al-Basheer**, 2012).

2.9 Wheat composition :

The composition of wheat flour varies considerably according to the class of wheat, its origin and the proportion of outer part removed by particular milling process.

- Moisture content of wheat is to only of economic significance , but is important in regard to its keeping qualities and its behavior on storage. (**Basdi** et al, 1978) mentioned that moisture content of different Sudanese wheat cultivar varies from about 6.33 to 8.87% (**Ahmed** , 1995).
- Ash content High extraction flour generally has high ash content. (Zeleny,1971)mentioned that ash content of whole wheat flour ranged

between 1.4 and 2 %. Reported that Ash content of whole flour of several Sudanese cultivars ranged between (1.03 and 1.24%) (Badi et al., 1978) and (Ahmed 1995).

- Protein content Wheat is considered superior compared to other cereals because of its nutritional value of wheat grain protein .(**Black** man and **Payne** .1987)reported that wheat is an important source of protein for people of the developing countries. The endosperm contain about 80 percent of the total amount of proteins in the whole kernel. (**Haldor** et al.1982) reported that protein content of whole wheat flour ranges between 10 and 16% while (**Ahmed**, 1995) reported that the protein content of four Sudanese wheat cultivars (Condor, Debra ,Elneilein and Nasser) ranges between 8.21 and 12.26%.
- Fat content The germ contains 6 –11 lipids, the bran 3 –5% and the endosperm 0.8 -1.5% (**Kent**, 1975).The germ is readily separated from the endosperm by milling; it is an important dietary supplement providing a rich source of vitamin E. The fats limit the keeping quality of wheat flour (**Anon**, 1987). Fat content of the whole white flour of Sudanese wheat Cultivars Depra, Elneelain,Condor, Sasarib., were found to be in the range of 2.15 to 2.35 and 1.33to 1.93%, respectively.
- Crude fiber content The fiber content increase with the amount of branny matter present Fiber is the indigestible carbohydrate in food which acts like a broome to sweep out the digestive.(**Egan** et al. 1981) found that the fiber percentage in whole wheat flour ranges between 1.8 and 2.5% and of white .

2.10 wheat grass:

Shoot of *Triticum aestivum* Linn. is called as a wheat grass, belonging to family: Gramineae. *Triticum* is a genus of annual and biennial grasses, yielding various types of wheat, native to south west Asia and the Mediterranean region. *T.aestivum* Linn. common or bread wheat, is widely cultivated almost all over the world. Generally, 15-20 species are recognized, of which 8 have been reported to occur in India. Wheat grass is a good source of mineral nutrients. It contains significant amount of iron, phosphorus, magnesium, manganese, copper & zinc. Wheatgrass is a rich source of chlorophylls with high vitamin E potency. Wheatgrass stimulates metabolism, restores alkalinity to the blood, its abundance of alkaline minerals helps reduce over acidity in the blood. Wheatgrass is also a detoxificant and helps restore healthy cells.

Wheat grass, young grass of common wheat plant, is freshly juiced or dried into powder for animal and human consumption- both the forms provide chlorophyll, amino acid, minerals, vitamins and enzymes. Many active compounds of wheat grass can cleanse the blood and neutralize and digest toxins in cells. Japanese scientist Dr. **Yoshihide Hagiware** M.D., found that the enzymes and amino acids in grass plants deactivated the carcinogenic and mutagenic effects of 3,4 benzpyrene, a substance found in smoked fish and charcoal-broiled meats. Wheatgrass is a good source of 'B' vitamins, which facilitate the use of carbohydrates for energy and aid the nervous and digestive system. Steadily supply of B vitamins is also essential for normal brain and body development.

2.11 Nutritional analysis of wheatgrass:

Scientific reports on nutritional analysis of wheatgrass have been published frequently in various journals (Kohler 1953, Hamilton et al., 1988, Laboratory Analyses 1989). Also, several reputed companies involved in growing and selling of wheatgrass have published analyses of wheatgrass. As is evident from table 3.1 and table 3.2, wheatgrass is a rich source of chlorophyll, various minerals like iron, magnesium, calcium, phosphorus, antioxidants like beta carotene, insoluble dietary fibers while being low in fat content.

2.12 Medicinal uses of wheatgrass

In today's fast lifestyle and fast-food world, deficiency of any or many of these biochemical factors could easily occur culminating into a disease or disorder. For example, as reported by (Altura and Altura, 1995), 'It is now becoming clear that a lower than normal dietary intake of magnesium can be a strong risk factor for hypertension, cardiac arrhythmias, ischemic heart disease, atherogenesis and sudden cardiac death. Deficiency in serum magnesium is often associated with arrhythmias, coronary vasospasm and high blood pressure'. Wheatgrass juice, being a rich source of magnesium, may replenish the deficiency of magnesium and improve the clinical picture.

Germination is a natural process occurred during growth period of seeds in which they meet the minimum condition for growth and development (Sangronis et al 2006). During soaking and germination for producing sprouts, seeds lose dry matter. (Chavan and Kadam, 1989) stated that the original dry weight of the seeds decreased during soaking and subsequent sprouting process due to leaching of materials and oxidation of substances from the seeds. (Chung et al, 1989) measured 9.4% decrease in dry matter

of sprouted barley seeds over 5 days, while (Abdallah et al .2014) found 14.8% loss for 7 days. During this period the chemical composition changes drastically because biochemical activity produces essential com-pounds and energy (Moongngarm and Saetung (2010). Wheatgrass can be traced back in history over 5000 years, to ancient Egyptian and perhaps even early Mesopotamian civilizations. It is pur-ported that ancient Egyptians found sacred the young leafy blades of wheat and prized them for their positive effect on their health and vitality. Wheatgrass can extracts for consume by two different types like squeezed or chewed then throw out. Wheatgrass has quickly become “the new age espresso” offered in smoothies and juices, salads, and even in powders and tablets and is one of the cereal grasses mostly used as a health drink (Ben-Arye et al 2002). Wheatgrass juice will provide you with more energy by fulfilling nutritional deficiencies and by removing wastes that clog your cells, blood, tissues and organs (Mujoriya and Ba-buBodla, 2011). Wheatgrass is a complete food that contains bio flavonoids, proteins and other important nutrients and helps in maintaining body functions (Mogra and Rathi, 2013).

2.13 Wheatgrass juice :

Wheatgrass juice is crude chlorophyll and can be taken orally and as a colon implant without toxic side effects. Chlorophyll is anti-bacterial and can be used inside and outside the body as a healer. Chlorophyll (wheatgrass) rebuilds the bloodstream. Studies of various animals have shown chlorophyll to be free of any toxic reaction.² The red cell count was returned to normal within 4 to 5 days of the administration of chlorophyll, even in those animals which were known to be extremely anaemia or low in red cell count. Liquid chlorophyll gets into the tissues, refines them and makes them over. Liquid chlorophyll washes drug deposits from the body. Chlorophyll neutralizes

toxins in the body , Chlorophyll improves blood sugar problems, overcome chronic inner-ear inflammation and infection, reduce varicose veins and heal leg ulcers, eliminate impetigo and other scabby eruptions, heal rectal sores, successfully treat inflammation of the uterine cervix, get rid of parasitic vaginal infections, reduce typhoid fever, and cure advanced pyorrhea .

Wheatgrass juice will provide you with more energy by fulfilling nutritional deficiencies (**Mujoriya R 2011, Kohler, Randle and Wagner 1939**). Both liquid and powder form provide chlorophyll, amino acids, minerals, vitamins, and enzymes. On the basis of recent studies wheat grass is considered as powerhouse of nutrients and vitamins for the human body. In the form of fresh juice, it has high concentrations of chlorophyll, active enzymes, vitamins and other nutrients. Wheat grass juice has chlorophyll that neutralizes infections, heals wounds, overcomes inflammations and gets rid of parasitic infections the three most important effects of wheat grass on the human body are: blood purification, liver detoxification and colon cleansing (**Miller 1941, Kothari S, Jain, A, Mehta, SC. and Tonpay, SD 2011**). This is because wheatgrass juice is the richest source of vitamins A, B, C, E and K, calcium, potassium, iron, magnesium, sodium, sulphur and 17 forms of amino acids (**Kapil S 2012**).

2.14 Green Blood therapy :

The liquid juice is referred as Green Blood and the use is called as Green Blood therapy. Wheat grass juice contains all the nutrients the body requires and is considered a complete health tonic (**Smith, 2000; Wigmore, 1986; Lam and Brush , 1950**).

2.15 Wheat Grass and Its Nutritional Values :

1. Wheatgrass juice is crude chlorophyll and can be taken orally and as a colon implant without toxic side effects. Chlorophyll is the basis of all plant life.
2. Wheatgrass is high in oxygen like all green plants that contain chlorophyll. The brain and all body tissues function at an optimal level in a highly-oxygenated environment.
3. Chlorophyll is anti-bacterial and can be used inside and outside the body as a healer.
4. Chlorophyll (wheatgrass) rebuilds the bloodstream. Studies of various animals have shown chlorophyll to be free of any toxic reaction. The red cell count was returned to normal within 4 to 5 days of the administration of chlorophyll, even in those animals which were known to be extremely an aemia or low in red cell count.
5. Dr. Ann Wigmore had been helping people get well from chronic disorders for 30 years using wheatgrass.
6. Liquid chlorophyll gets into the tissues, refines them and makes them over.
7. Wheatgrass juice is a superior detoxification agent compared to carrot juice and other fruits and vegetables. Dr. Earp-Thomas, associate of Ann Wilmore, says that 15 pounds of wheatgrass is the equivalent of 350 pounds of carrot, lettuce, celery and so forth.
8. Liquid chlorophyll washes drug deposits from the body.
9. Chlorophyll neutralizes toxins in the body. .
10. Chlorophyll improves blood sugar problems.
11. In the American Journal of Surgery, 1940, Benjamin Ruskin, M.D. recommends chlorophyll for its antiseptic benefits. The article suggests

- the following clinical uses for chlorophyll to clear up foul smelling odors, neutralize strep infections, heal wounds, hasten skin grafting, cure chronic sinusitis, overcome chronic inner-ear inflammation and infection, reduce varicose veins and heal leg ulcers, eliminate impetigo and other scabby eruptions, heal rectal sores, successfully treat inflammation of the uterine cervix, get rid of parasitic vaginal infections, reduce typhoid fever, and cure advanced pyorrhea in many cases.
12. A small amount of wheatgrass juice in the human diet prevents tooth decay.
 13. Drink wheatgrass juice for skin problems such as eczema or psoriasis.
 14. Wheatgrass juice keeps the hair from graying.
 15. Pyorrhea of the mouth: Lay pulp of wheatgrass soaked in juice on diseased area in mouth or chew wheatgrass, spitting out the pulp.
 16. Wheatgrass juice improves digestion.
 17. Wheatgrass juice is great for constipation and keeping the bowels open. It is high in magnesium.
 18. Dr. Bircher, a research scientist, called chlorophyll 'concentrated sun power'. He believes that chlorophyll increases the function of the heart, affects the vascular system, the intestines, the uterus and the lungs.
 19. According to Dr. Bircher, nature uses chlorophyll (wheatgrass) as a body cleanser, re-builder and neutralizer of toxins.
 20. Wheatgrass juice can dissolve the scars that are formed in the lungs from breathing acid gases. The effect of carbon monoxide is minimized since chlorophyll increases hemoglobin production.

21. Wheatgrass juice is great for blood disorders of all kinds.
22. The pH (hydrogen molecules) value of human blood and Wheatgrass both is about 7 (alkaline) & is therefore quickly absorbed in the blood and is highly beneficial.

2.16 Method of preparation of Wheat Grass Powder by Different Drying Process :

1. Hot air oven drying (50°C, 6 Hour), (60°C, 5 Hour).
2. Microwave drying (600 W, 15 min.), (800W, 10 min.).
3. Vacuum drying (50°C, 15lb, 7hr).
4. Sun drying
5. Shady drying.

CHAPTER THREE

Material and methods

3.1 Materials:

The wheat grain sample collected from Wad Medani Agriculture Research Center . The variety used in this study is AlNeelain. The sugar and gum Arabic were purchased from the local market Shambat.

3.2 methods:

3.2.1 Method of Germination:

1. Adequate quantity of unpolished wheat grain were soaked overnight in water in a container.
2. On the next day, the soaked wheat-grain were spread on the surface of the soil over Burlap sack .
3. A thin layer of soil was sprinkled on the wheat grains.
4. The surface was covered with a burlap sack to provide darkness, which helps the sprouting.
5. The burlap sack was kept in laboratory near to source of light .
6. Next day the burlap sack was uncovered to spray on some water and was covered again with the burlap sack.
7. Step 6 was repeated everyday until sprouting took place, after which the was burlap sack left uncovered and watered everyday for 8 days.
8. On 9th day the wheatgrass was harvested by cutting manually By scissors about 1/2" above the surface of the soil , the length of the shoots obtained was 15 cm .

3.2.2 Shoot drying

:The collected shoots was placed in aluminum foil on oven at 55 °C for 36 hours ,and then milled by electric grinder to produce wheat grass powder. The powder was stored in plastic bags till use .

Table (1) Wheat grass powder juice formula

Wheat grass powder	4 gram
Water	500 ml
Gum Arabic	4 gram
Sugar	75 gram

3.2.3Preparation of juice :

5 gram of wheat grass powder were dissolved in 400 ml of distilled water and completed to 500 ml the content is vigorously mixed , 4 gram of gum Arabic were added beside 75 gram of sugar powder,mix well and keep the juice cool for further tests .

3.3 Physiochemical Analysis

3.3.1Moisture content

Moisture content was determined according to the Association of official's analytical chemists AOAC (2003) as follows: Two grams of each sample were weighed in clean dry and pre-weighed crucible and then placed in an oven at 105C° and left overnight. The crucible was transferred to desiccators and allowed to cool and then weighed. Further placement in the oven was carried out until constant weight was obtained. Moisture content was calculated using the following formula:

$$MC\% = \frac{(W_2 - W_1) - (W_3 - W_1) \times 100}{W_2 - W_1}$$

Where:

Mc: moisture content,

W1: weight of empty crucible

W2: weight of crucible with the sample,

W3: weight after drying.

3.3.2 Total ash

Ash content of the sample was determined according to the method of AOAC (1990) as follows: Two grams of sample were placed in a clean dry pre-weighed crucible, and then the crucible with its content ignited in a muffle furnace at about 550°C for 3 hours or more until light gray ash was obtained. The crucible was removed from the furnace to a desiccator to cool and then weighed. The crucible was re-ignited in the furnace and allowed to cool until a constant weight was obtained. Ash content was calculated using following equation:

$$AC\% = \frac{(W_2 - W_1)}{W_3} \times 100$$

Where:

Ac: ash content.

W1: weight of empty crucible.

W2: weight of crucible with ash.

W3: weight of sample.

3.3.3 Crude protein:

Crude protein of the sample was determined by using the micro-Kjeldahl method according to AOAC (1990) as follows:

- Digestion: 1

0.2 gram of sample was weighed and placed in small digestion flask (50 ml). About 0.4 gram catalyst mixture (96% anhydrous sodium sulphate and 3.5% copper sulphate) was added, 3.5 ml of approximately 98% of H₂SO₄ was added. The contents of the flask were then heated on an electrical heater for 2 hours till the color changed to blue-green. The tubes were then removed from digester and allowed to cool.

- **Distillation:**

The digested sample was transferred to the distillation unit and 20 ml of NaOH (40%) were added. The ammonia was received in 100 ml conical flask containing 10 ml of 2% boric acid plus 3-4 drops of methyl red indicator. The distillation was continued until the volume reached 50 ml.

- Titration:

The content of the flask were titrated against 0.02 N HCL. The titration reading was recorded. The crude protein was calculated using the following equation;

$$CP\% = \frac{(T - B) \times N \times 14 \times 100 \times 6.25}{W_s \times 1000}$$

Where:

CP = crude protein

T = Titration reading

B = Blank titration reading

N = normality of HCL

W_s = sample weight

1000 = to convert to mg

3.3.4 Fat content

Fat was determined according to the method of AOAC (1990) using soxhlet apparatus.

An empty clean and dry exhaustion flask was weighed. About 5 gram of sample was weighed and placed in a clean extraction thimble and covered with cotton wool. The thimble was placed in an extractor. Extraction was carried out for 6 hours with petroleum ether. The heat was regulated to obtain at least 15 siphoning per hour. The residual ether was dried by evaporation. The flask was placed in an oven at 105°C till it dried completely and then cooled in a desiccators and weighed. The fat content was calculated using the following equation:

$$FC(\%) = \frac{W_2 - W_1 \times 100}{W_s}$$

Where

FC= Fat content

W1= Weight of extraction flask

W2= Weight of extraction flask with fat

Ws= Weight of sample

3.3.5 Crude fiber

Crude fiber was determined according to AOAC (1990). Two grams of defatted sample were treated successively with boiling solution of H₂SO₄ and KOH (0.26 N and 0.23 N, respectively). The residue was then separated by filtration, washed and transferred into a crucible then placed into an oven adjusted to 105°C for 18 – 24 hours. The crucible then with the sample was weighed and ached in a muffle furnace at 500°C and weighed. The crude fiber was calculated using the following equation:

$$CF(\%) = \frac{W_1 - W_2 \times 100}{W_s}$$

Where:

CF = Crude fiber

W₁ = Weight of crucible with sample before ashing

W₂ = Weight of crucible with sample after ashing

W_s = weight of sample

3.3.6 Carbohydrate :

Determination of Carbohydrates :

The carbohydrates were calculated by difference. The sum of moisture fat, protein and ash contents was subtracted from 100 as it was described by West et al. (1988).

3.4 Sensory Evaluation:

This test included 16 panelists ranging from 20 to 26 years of age from Sudan university college of agricultural studies. Prior to sensory evaluation of wheat grass powder juice, a 1-5-point hedonic scale was used, where 1 was the lowest (least liked) and 5 was the highest score (most liked).

Flavor attributes were also surveyed by asking panelists to evaluate the scores of color, flavor, taste (attribute) and overall acceptability by the mean of scale.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Chemical composition of wheat grain:

Chemical composition of wheat grain there blends were shown in table (1)

4.1.1 Moisture Content:

Moisture Content of wheat s grain was (13.65) ,these results were higher than (**Abd Alrahaman and Omoniyi,2017**)who reported that the Moisture Content of wheat seed was (6.9).

4.1.2 Protein Content

protein Content of wheat grain was (11.613) ,these results were less than (**Abd Alrahaman and Omoniyi,2017**)who reported that the protein Content of wheat seed was (12.39).

4.1.3 Fat Content:

Fat Content of wheat seed was (1.370),,these results were less than (**AbdAlrahaman and Omoniyi, 2017**) who reported that the fat content of wheat seed was (2.50).

4.1.4 Fiber Content:

Fiber content of wheat grain was (1.630), these results were higher than (AbdAlrahaman and Omoniyi, 2017) who reported that the Moisture Content of wheat seed was (1.14).

4.1.5 Carbohydrate Content:

CHO content of wheat grain was (71.36), these results were less than (AbdAlrahaman and Omoniyi, 2017) who reported that the CHO Content of wheat seed was (75.65).

4.1.6 Ash Content:

ASH content of wheat grain was (0.373), these results were higher than (AbdAlrahaman and Omoniyi, 2017) who reported that the Moisture content of wheat seed was (1.42).

Table No(2) obtained the Chemical composition of wheat seeds.

Descriptive Statistics for SAMPLE = A	
Variable	Mean \pm SD
Ash	0.373 \pm 0.025
CHO	71.36 \pm 0.140
Fat	1.370 \pm 0.030
Fiber	1.630 \pm 0.036
Moisture	13.65 \pm 0.090
Protein	11.613 \pm 0.035

4.2 Chemical composition of wheat grass powder there blends were shown in table (3)

4.2.1 Moisture Content :

Moisture Content of wheat grass powder was (6.463) ,these results were less than (**Tania etal,2017**) who reported that the Moisture Content of wheat grass powder was (9.055) .

4.2.2 Protein Content :

Protein content of wheat grass powder was (25.40) ,these results were higher than (**Tania etal,2017**) who reported that the protein Content of wheat grass powder was (22.938) .

4.2.3 Carbohydrate Content:

CHO content of wheat grass powder was (51.617) ,these results were less than (**Tania etal,2017**) who reported that the CHO Content of wheat grass powder was (54.235) .

4.2.4 Crude fiber :

Fiber content of wheat grass powder was (9.500) ,these results were higher than (**Tania etal,2017**) how reported that the fiber Content of wheat grass powder was (4.65) .

4.2.5 Ash Content :

Ash content of wheat grass powder was (5.200) ,these results were less than (**Tania etal,2017**)who reported that the ASH Content of wheat grass powder was (6.875) .

4.2.6 Fat Content :

Fat content of wheat grass powder was (1.740) ,these results were less than (Tania etal,2017) how reported that the ASH Content of wheat grass powder was (2.25) .

Table No (3) Chemical composition of wheat grass powder .

Descriptive Statistics for SAMPLE = B	
Variable	Mean ± SD
Moisture	6.463 ± 0.145
Protein	25.40± 0.180
Fat	1.740± 0.020
Ash	5.200± 0.040
Fiber	9.500± 0.050
CHO	51.617 ± 0.198

Table(4)Physical proprieties of wheat grass juice:

Paramater Sample	Titration acidity (%)	TSS (%)	pH
wheat grass juice	1.26 ±0.01	14.51 ±0.01	6.1 ±0.1

***Mean ±Standard Deviation**

4.3 Sensory Evaluation:

The results showed that the color recorded (4),flavor(4.12) , the taste recorded (4.5) and the overall (4.25).

The results of Sensory Evaluation obtained showed that the product is highly acceptable by the panelists .

TableNo (5) Sensory Evaluation of wheat grass powder juice.

Sample	Colour	Flavor	Taste	Overall
A	4.0 ±0.81	4.12 ±0.8	4.5 ±0.73	4.25 ±0.44

Mean ±Standard Deviation

A= wheat grass juice

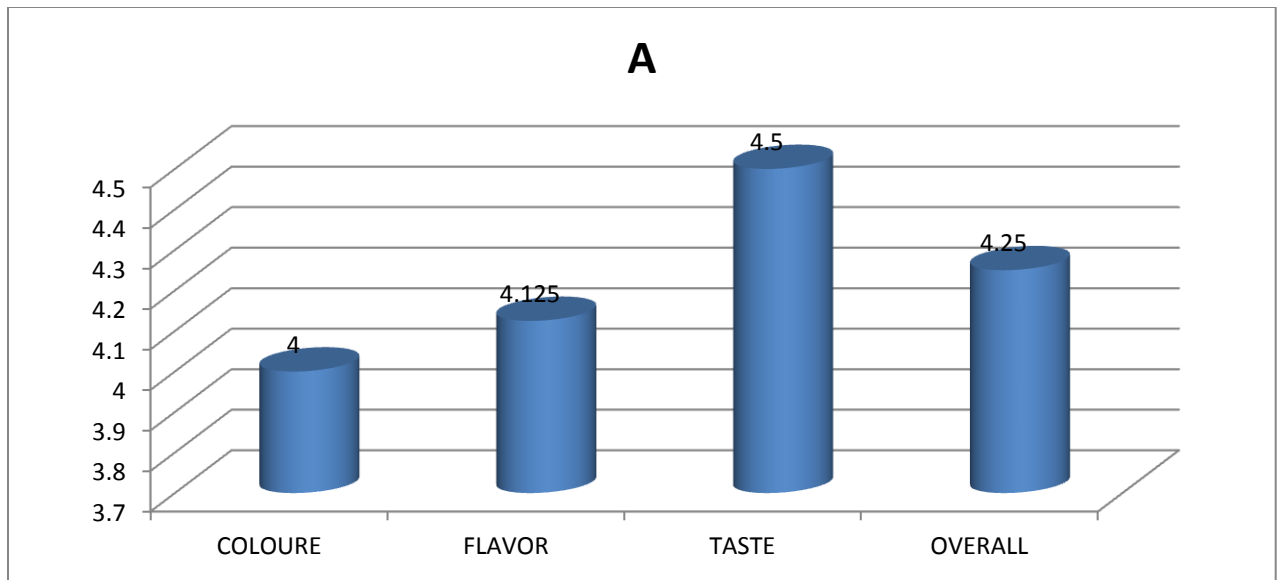


Fig (1) Sensory Evaluation of wheat grass powder

CHAPTER FIVE

Conclusion and recommendation

5.1 Conclusion :

Wheat grass powder can be produced by germination wheat grain for 10 days , then the shoots product will be harvested and dried using a suitable drying method , grinded and the powder will be storied till use .wheat grass powder can be used to produce juice .

Based on the results of this study , the juice prepared from the wheat grass powder is acceptable by the consumer .

5.2 Recommendations:

- 1- it is recommended to produce juice from wheat grass powder .
- 2- Future research should be carried out on the wheat grass powder to determine vitamins and minerals content.
- 3- Additional studies needed to determine storage conditions and the shelf life of juice.

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APPENDICES



Plate 1 : Germinated seeds



Plate 2 :Wheat grass shoots