بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Agricultural Studies

Department of Food Science and Technology

Production of Paste from Legumes and Cereals Rich in Essential Amino Acids to Replace meat in Burger Processing

انتاج عجينة من البقوليات والغلال غنية بالأحماض الامينية الاساسية كبديل للحم في تصنيع البيرقر

A Dissertation submitted to Sudan University of Science and Technology in Partial fulfillment for the Degree of B Sc in Food Science and Technology

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October, 2020

الاية

(فَلْيَنظُرِ الْإِنسَانُ إِلى طَعَامِهِ * أَنَّا صَبَبْنَا الْمَاء صَبًّا * ثُمَّ شَقَقْنَا الْأَرْضَ شَقًّا * " فَأَنبَتْنَا فِيهَا حَبًّا * وَعِنَبًا وَقَضْبًا * وَزَيْتُونًا وَنَخْلًا * وَحَدَائِقَ غُلْبًا * وَفَاكِهَةً وَأَبًّا * مَّتَاعًا لَّكُمْ وَلِأَنْعَامِكُمْ *)

صدق الله العظيم

(عبس 24 -32)

DEDICATION

To

Our fathers and mothers

Our brothers and sisters

Our teachers and to all friends

ACKNOWLEDGEMENTS

With all due humbleness and gratitude we render ultimate thanks and special praise to Allah (Almightily) who gave us health, power and Patience to accomplish and conduct this research.

We deeply thank and appreciate our supervisor **Prof. Dr. Ahmed El-wad El-Faki** encouragement throughout the duration of our study. For his continuous assistance, valuable advices, patience and encouragement throughout the duration of our study.

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Abstract

The aim of this study was to prepare a paste of, grains (cereals and legumes) containing the optimum proportions of essential amino acids compared to the content of meat from the essential amino acids so that it can be used as a substitute for meat in processed burger, reducing cost and with similar nutritional value of meat, Three pastes were made based on amino acid ratios with acceptable or appropriate physiochemical properties, and the results of laboratory tests showed the highest proportions of protein in paste 3 (19.49%). While the theoretical basis on which the paste was made was proven that it contains the best ratio of essential amino acids. As for the sensory evaluation, the same paste indicated that it is the best in terms of taste, color, smell and texture compared to the other pastes (1,2) and accordingly we recommend using the paste No. (3)in burger preparation .

الملخص

الهدف من هذه الدراسة اعداد خلطة من حبوب الغلال والبقوليات تحتوي النسب المثلى من الأحماض الأمينية الأساسية مقارنة بمحتوى اللحم من الأحماض الأمينية الأساسية بحيث يمكن استخدامها كبديل للحم في انتاج البيرقر بتقليل التكلفة وبنفس القيمة التغذوية للحوم , تم تصنيع ثلاثة خلطات بناءا على نسب الاحماض الامينية مع خواص فيزوكيميائية مقبولة واظهرت نتائج الاختبارات المعملية أعلى نسب من البروتين في من المصنوع البيرقر الخلطة رقم (3) (19.49%) بينما الأساس النظري الذي كونت به الخلطة اثبت انها تحتوي على أفضل نسب من الأحماض الأمينية الأساسية اما التقيم الحسي اشار الى ان 3 رقم الخلطة من المصنوع البيرقر الأفضل من حيث الطعم واللون والرائحة والقوام مقارنة بالخلطات الاخرى (1،2) وبناء على ذلك نوصي باستخدام الخلطة رقم 3 للتصنيع و انتاج البيرقر.

CHAPER ONE

INTRODUCTION

Meat is defined as those animal tissues, which are suitable for use as food. All processed or manufactured product, which might be prepared from tissues, are included in this definition. The processed meat products are define as those in which properties of fresh meat have been modified by use of one or more procedures, such as grinding or chopping addition of seasoning, alteration of color or heat treatment .Since meat contains an abundance of proteins with high biological value, meat is categorized as a protein food group in dietary food guides. In other words, in terms of nutrition, meat excellent diet source of essential amino acids. Meat also plays an important role in supplying our diet with minerals and vitamins, such as iron, zinc, selenium, and B vitamins. However, consumers often associate meat and meat products with a negative health image. This regrettable image of meat is mainly due to its content of fat, saturated fatty acids, and cholesterol, and their association with chronic diseases, such as cardiovascular diseases. Some types of cancer, , and obesity. Also, intake of sodium chloride from meat ea products has been linked to hypertension. The public has become increasingly concerned about health and nutrition matters in recent years and this has sparked the commercialization of natural foods consumed as dietary supplements. With the demand for nutritious and healthy food products, the researches have to focus their creation towards utilization of plant sources in preparing(WHO.FAO.1971).

cereal is any grass cultivated (grown) for the edible components of its grain (botanically, a type of fruit called a caryopsis), composed of the endosperm, germ, and bran. The term may also refer to the resulting grain itself (specifically "cereal grain"). Cereal grain crops are grown in greater quantities and provide more food energy worldwide than any other type of crop [1] and are therefore staple crops. Edible grains from other plant families, such as buck wheat (Polygonaceae), quinoa (Amaranthaceous) and chia (Lamiaceae), are referred to as pseudocereals.In their natural, unprocessed, whole grain form, cereals are a rich source of vitamins, minerals, carbohydrates, fats, oils, and protein. When processed by the removal of the bran, and germ, the remaining endosperm is mostly carbohydrate. In some

developing countries, grain in the form of rice, wheat, millet, or maize constitutes a majority of daily sustenance.(Bressani , R.O.W Nilson ,M . Behar , and N.S .Scrimshaw,1960).

Legumes are basically a family of vegetables or plants that feature a pod with seeds inside it. These seeds are sometimes referred to as pulses or edible seeds. Legumes include peas, beans, peanuts, and lentils. The richness of legumes in vitamins and minerals is the top reason why legumes are commonly used in cooking or in making salads. Here are some of the health benefits of legumes that you need to know.This group of plants are known as excellent source of both protein and fiber. Protein is found in every cell of our bodies. As the building block of human body, protein is needed in various body processes. This is primarily because protein is the second most abundant chemical in the body next to water. It regulates metabolism and cell division. One cup of legumes, as among top sources of protein, contains 33% of the daily recommended allowance (DRA) for women and 27% DRA for men.Aside from protein; legumes are also rich in fiber. Fiber is essential for the body to balance the blood sugar and lower the cholesterol level in our bloodstream. It also prevents constipation. Legumes are also abundant with vitamins and minerals, which is why they are widely used in soups, salads, and smoothies.(Aykroyd,W.R.,andJ.Woughty,1964)

Most animal sources of protein, such as meat, poultry, fish, eggs, and dairy, deliver all the amino acids your body needs, while plant-based protein sources such as grains, beans, vegetables, and nuts often lack one or more of the essential amino acids. However, that doesn't mean you have to eat animal products to get the right amino acids. by eating a variety of plant-based sources of protein each day you can ensure your body gets all the essential amino acids it needs . (Lawrence Robinson, , 2018) .

General objective:

To produce a paste from grains containing essential amino acids for burger making.

Specific objectives:

1/ To formulate a product similar to meat in nutritional value.

2/ To control as much as possible sensory attribute which lead to produce palatable product.

3/ To introduce this paste in burger production

CHAPTER TWO

LITRETURE-REVIEW

2-1 Importance of protein for human :

2-1-1 Food source of protein:

Although protein is widely distributed in nature. few food contain large amounts of protein, for example animal foods such as meat poultry fish milk cheeses and eggs contain high quality protein and it sufficient quantity to make them first in order of importance however protein is a complete protein equal in quality to most animal proteins and soybeans are high in protein content other legumes provide a good quality of protein but contain an insufficient amount of methionine. Protein the quality remains to be assessed grain product are low in protein but because they consumed in large amounts they contribute a significant proportion of protein to the amino acids lysine. (Eva D. welson , Kacherine H. Ficher , Pilar A. Garcia , 1979).

Table (1): Nutrient value of wheat , millet , lentil ,cowpea , rice (g/100g)

Nutrient	Fat	Protein	carbohydrate	Fiber
Wheat	0.44	5.61	33.82	8.19
Millet	1.74	6.11	41.19	2.26
Rice	0.4	4.4	53.2	0.6
Lentil	0.75	17.86	39.86	15.64
Cowpea	2.1	24	60	11

2-1-2 Function of protein:

Dietary proteins provide amino acids to build and maintain tissues and from enzyme some hormones and antibodies proteins function in some body requlating processes and a source of energy. (Eva D. welson , Kacherine H. Ficher , Pilar A.Garcia , 1979).

2-1-3 The Roles of essential amino acids in the body:

The nine essential amino acids perform a number of important and varied jobs

1. Phenylalanine: is a precursor for the neurotransmitters tyrosine, dopamine, epinephrine and norepinephrine. It plays an integral role in the structure and function of proteins and enzymes and the production of other amino acids .
2. Valine: is one of three branched-chain amino acids, meaning it has a chain branching off to one side of its molecular structure. Valine helps stimulate muscle growth and regeneration and is involved in energy production.
3. Threonine: is a principal part of structural proteins such as collagen and elastin, which are important components of the skin and connective tissue. It also plays a role in fat metabolism and immune function
4. Tryptophan: Though often associated with causing drowsiness, tryptophan has many other functions. It's needed to maintain proper nitrogen balance and is a precursor to serotonin, a neurotransmitter that regulates your appetite, sleep and mood.
5. Methionine: plays an important role in metabolism and detoxification. It's also necessary for tissue growth and the absorption of zinc and selenium, minerals that are vital to your health.
6. Leucine: Like valine, leucine is a branched-chain amino acid that is critical for protein synthesis and muscle repair. It also helps regulate blood sugar levels, stimulates wound healing and produces growth hormones.
7. Isoleucine: The last of the three branched-chain amino acids, isoleucine is involved in muscle metabolism and is heavily concentrated in muscle tissue. It's also important for immune function, hemoglobin production and energy regulation) .

8. Lysine: plays major roles in protein synthesis, hormone and enzyme production and the absorption of calcium. It's also important for energy production, immune function and the production of collagen and elastin
9. Histidine: is used to produce histamine, a neurotransmitter that is vital to immune response, digestion, sexual function and sleep-wake cycles. It's critical for maintaining the myelin sheath, a protective barrier that surrounds your nerve cells

As you can see, essential amino acids are at the core of many vital processes.

Though amino acids are most recognized for their role in muscle development and repair, the body depends on them for so much more.

That's why essential amino acid deficiencies can negatively impact your entire body including your nervous, reproductive, immue and digestive systems.

All nine essential amino acids perform varied roles in your body. They're involved in important processes such as tissue growth, energy production, immune function and nutrient absorption. (Hegsted , D.M , 1973).

Table (2) : The requirement of the essential amino acids :

	Requirement (per kg > body wt) mg/day		
Amino acid	infant (3---6 mo)	child (10---12 yr)	Adult
Histidine	33	-	-
Isoleucine	80	28	12
Leucine	128	42	16
Lysine	97	44	12
Total s-containing amino acid Methionine ,cyctine ,cycteine	45	22	10
Total aromatic amino acids Phenylalanine ,tyrosine	132	22	16
Threonine	63	28	8
Tryptophan	19	4	3
Valine	89	25	14

Source: National Academy Science (1974)

Table (3):the essential amino acids ratio in rice , lentil, cowpea , millet and wheat

Amino acids / Ingredient	Isoleucine Mg	Leucine mg	Lysine mg	Methounin mg	Phenylalanine mg	Threonine mg	Tryptophan Mg	Valine Mg
Rice	296	581	255	150	342	234	95	408
Lentil	1045	1847	1739	194	1266	960	231	1211
cowpea	895	1647	1599	273	1209	842	254	1060
Millet	440	950	290	310	520	420	150	660
wheat	349	644	182	140	468	246	93	386

Amino acid in beef and veal

852	852	1435	1573	478	778	812	198

Source: Jansen, G.R (1977)

2-1-4 Protein deficiency :

Protein deficiency is when your intake is unable to meet your body's requirements. An estimated one billion people worldwide suffer from inadequate protein intake. Symptoms of protein deficiency are non specific they include loss of weight fatigue, irritability and lack of energy. In youngsters growth is retarded. (AdamE.B, 1969).

Table (4): silent Protein deficiency disease and there comparison :

Kwashiorkor	Marasus
Caused by severe of protein deficiency in diet. May occur even though the intake +of energy is adequate.	Caused by deficiency of proteins and total food calories in diet.
Affects children 1-3 years of age.	Commonly affects infants below 1 year of age.
Stomach protrudes out and oedema (swollen due to water retention) in legs and face.	Ribs are prominent and no oedema.
Skin becomes dark and peels off.	Skin is dry and wrinkled.
Hair change color, lose lustre and become down.	No change in hair.
No degeneration of the muscles.	Degeneration of the muscles, with the body becoming weak.

Source: Adam E.B (1969).

2-2 Obstacle that prevent human form getting animal protein:

2-2-1 Economic obstacles:

in the industrialized countries the individual daily intake from meat is high, but in developing countries was less than 10 kg/yr (56kg man) of consumption which be considered insufficient and these leads to malnutrition. And the majority of the malnutrition in developing countries due to the economic problems (low income).

2-2-2 Healthy obstacles:

According to the British study, published by the site "CARE 2" on health, the risk of red meat is the following diseases:

2-2-2-1 Cancer:

The study proved that eating meals that contain large quantities of meat, and lacking fiber and antioxidants, have a higher risk of colon and rectal cancer

2-2-2-2 Heart diseases:

People who are keep eating red meat in nutrition to obtain the proteins needed to build their bodies have increased risk factors for coronary artery disease, blood vessels, and heart attacks.

2-2-2-3 Brain diseases:

The excessive consumption of red meat causes a stroke, as it impedes blood flow to the brain. The study proved that excessive consumption of animal proteins causes weight gain, especially in women than in men.

2-2-2-4 Diabetes incidence:

Because red meat is rich in saturated fats and cholesterol, doctors have confirmed that this leads to type 2 diabetes .
As for the method of eating meat, and the recommended amount, the doctors determined the conditions for eating it for the meat to be accompanied by a healthy food, such as vegetables, and a green salad dish, and it is preferable that the meat be cut, and the weight of the steak does not exceed 120 grams.

2-2-3 By choice:

Meat is an integral part of many cultural / religious festivals, holidays and other rituals. Not eating meat is more than just a sacrifice of the palate. It is important to people for reasons of tradition and cultural integrity. Most religions, including Hinduism, Christianity, Buddhism, Islam and Judaism, have specific (often meat-based) foods that hold specific symbolic or spiritual value (as well as restrictions on some meats or how the meat is cooked/prepared

2-2-3-1 Hindus:

Beef is specifically forbidden in the Hindu religion, as they believe in the sanctity of cows, and is greatly appreciated, and in some Indian provinces there are laws against the sale and slaughter of cows.

2-2-3-2 Buddhism:

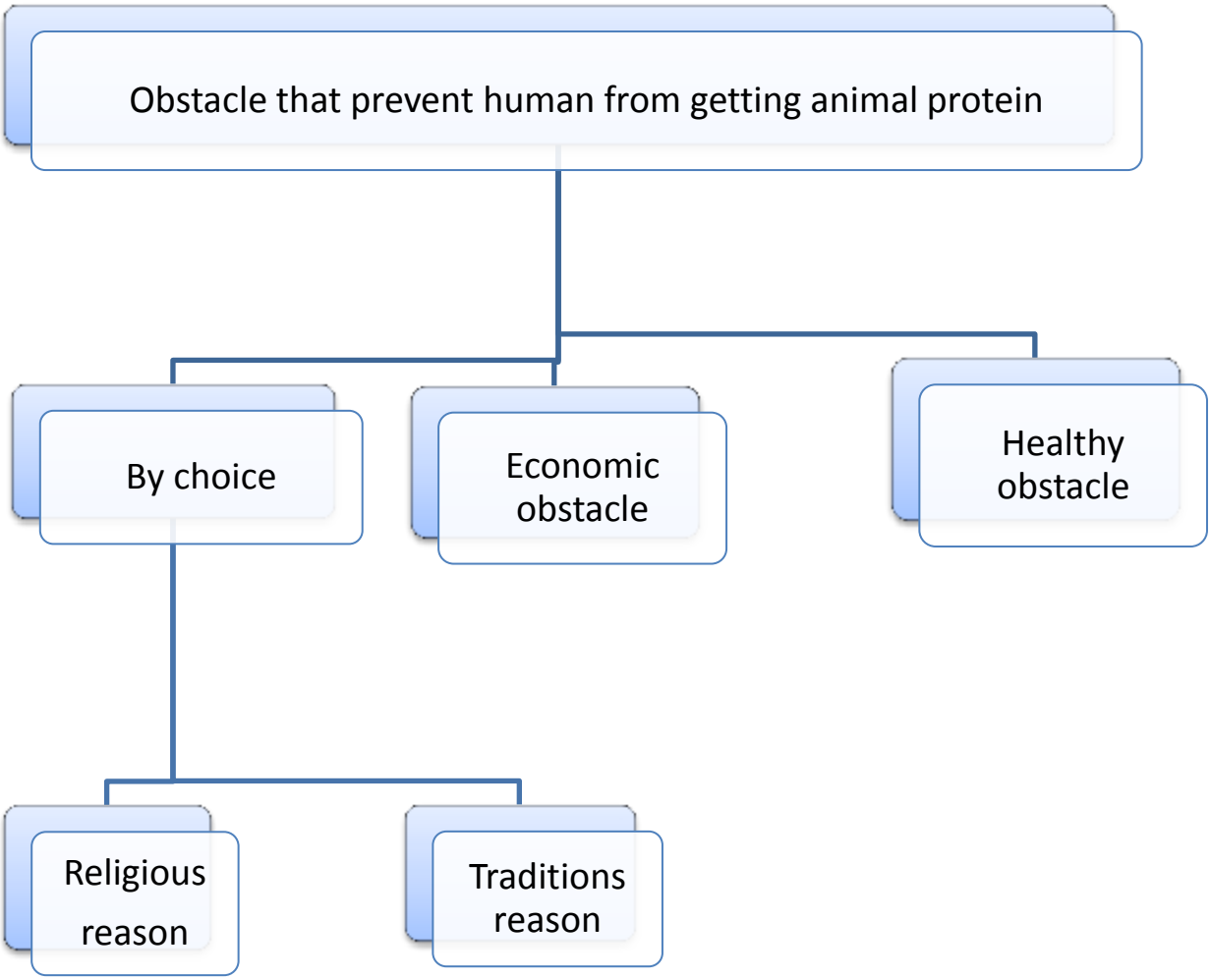
Like Hindus, Buddhists believe in reincarnation, and refrain from slaughtering animals, as their souls may have dwelt in other human bodies, and their belief in nonviolence encourages them to follow a vegetarian diet.

2-2-3-3 Sikhism:

Encourages its followers to avoid meat and a vegetarian diet that includes vegetables, fruits, and milk, such as Hindus, as they share a belief in nonviolence.

2-2-3-4 Christianity:

-Catholic Christians refrain from eating meat and everything related to it during their fasting period, (Linda Johson Larsen , 2012)



- Figer (1): Obstacle that prevent human from getting animal protein

2-3 Vegetarisches :

The constituents are mostly vegetable substitutes for meat such as beans, soy, wheat, peas, and lupine. In addition, we are also conducting parallel research on other plant materials. The plant materials used are distinguished for their special taste. For example, pea protein has a special flavor, and gluten from wheat has own special flavor. But despite that, we can produce vegetable slices with a flavor similar to meat. In order to reach this taste we must add some flavors and some spices, which must also be of vegetable origin. Thus, a taste of real pork, veal and other meat can be obtained. The raw materials that are used in this product are very rich in protein, with a protein ratio between 65 and 90 percent. Accordingly, the final product is also very rich in protein and thus comparable to meat. In addition, the product has very little fat content that can be compared to dry meat cuts. In addition, the vegetable steaks they produce have a more nutritional advantage than meat, as they have a large amount of fiber. There are, of course, other reasons that set it apart from regular meat, especially with regard to nature conservation and sustainability: This is because plant products preserve more natural resources compared to meat. looks at the production and uses of a range of meat alternatives from different sources including: soya beans; wheat protein; pea and wheat protein; and myco-protein. Compares the nutrient profiles with those of meat. Concludes that the way forward is to create new products based on plant proteins and to veganism existing vegetarian meat alternatives. (Schnitzel Fraunhofer Institute , 2011).

2-4 Meat and vegetable protein blends for engineered foods:

The meat industry in the United States offers the biggest volume potential for vegetable protein reports a tonnage of 4,377,937,031 pounds of sausage products. Our research with various protein sources is discussed. Emphasis is placed on soy protein products currently available and approved by government agencies. Formulations and requirements for satisfactory products is outlined with economic justifications for soy flour, concentrates and isolates. A thorough discussion of extruded and/or engineered foods is presented showing utilization of mechanically deboned meats, recovered meat proteins from pork and beef rendering, and vegetable proteins in combination with beef and pork. The nutritive values of mechanically deboned chicken and structured soy protein gave PERs over 3.0 with good amino acid balance (. American Meat Institute,1977)

2-5 Burger Production for vegetarian with addition of mushroom and soybean:

The aim of this study was a trial to prepare burger for vegetarians using mushroom (Agaricus bisporus), soybean and assess the effect of added mushroom on physicochemical and organoleptic characteristics of produced burger. physicochemical composition and sensory evaluation of mushroom burger of 75% mushroom, 60% mushroom and 15% soybean , 15% mushroom and 60% soybean to replace meat in burger, compared to normal burger (control)were carried out. The result obtained revealed that the physicochemical composition of significant difference (p5 0,05) between the control burger and the burger of 75 % mushroom, 60% mushroom and 15%soybean and 15% mushroom and 60%soybean. The high result in moisture, ash and carbohydrate was found to be 73.00%, 2.27% and 21.03, respectively and low in fat (0.18) and PH (0.36) which was in 75% mushroom. The high result in protein was found in15% mushroom and 60° o soybean (21.81).The sensory evaluation revealed that there was no significant difference (p5 0,05) in color and tenderness except for flavor, taste and total acceptability burger for vegetarian was in 75% mushroom, 60%mushroom and 15% soybean and 15% mushroom and 600 o soybean, the high flavor and tenderness was found in 60° o mushroom and 15% soybean (B)and 15% mushroom and 60° soybean(C). According to this study mushroom and soy bean are recommended in making burger for vegetarians. (Braa Modther Amen ,Tagwa Azhary Hhamid Aalmahadi and Saga Al higazi Mohmoud , 2018) .

CHAPTER THREE

METARIALS AND METHODS

3-1 Materials:

3-1-1 Production of the paste:

We used 5 grains (lentil , rice , millet , cowpea and wheat) as base ingredient and other materials was spices and tomato sauce and slices of onions and garlic .

3-1-2 Theoretical base of the pastes :

Based on the known scientific fact which say that Proteins can complement each other the amino acid deficits of one protein can be supplied by another protein, and the two together can provide a higher quality protein than either alone , For example, most legumes are deficient in the sulfur-containing amino acids methionine and cystine but are usually high in lysine content , According to the essential amino acid ratio that found in many reference for our ingredient (lentil, rice, cowpea, millet, wheat). we choice particular weight to make the final ratio of amino acid in our product near or similar to meat essential amino acids ratio keeping in mind that there is some factor control this process . We make Three different pastes depending on weight of each ingredient that we use

3 -1 -2-1 formulation of Paste 1:

the ratio was 1:1 from rice lentil cowpea millet wheat that mean 25 gm from each one of those ingredient when you collect the amino acid (isoleucine) from each one you found that in final ratio equal 6.68 in final product As shown in table 5

R + L + C +M =P1 0.74 + 2.61 + 2.23 + 1.1 = 6.68

R= isoleucine ratio in 25 gm form rice .

L= isoleucine ratio in 25 gm form lentil.

C= isoleucine ratio in 25 gm form cowpea.

M= isoleucine ratio in 25 gm form millet .

P1= pasts 1.

According to this example above this below table show the ratio of amino acid in three pastes .

3-1 -2-2 formulation of Paste 2 :

The ratio was 0.5: 1.5:1:1 from (rice (12.5 gm) lentil(37.5 gm) cowpea(25gm) millet (25 gm)) . from each one of those ingredient when you collect the amino acid (isoleucine) from each one you found that in final ratio equal 6.68 in final product As shown in table 6

R + L + C +M =P2 0.37 +3.915 +2.23 +1.1=7.61

R= isoleucine ratio in 12.5 gm form rice .

L= isoleucine ratio in 37.5 gm form lentil.

C= isoleucine ratio in 25 gm form cowpea.

M= isoleucine ratio in 25 gm form millet .

P2= pasts 2

3-1 -2-3 formulation of Paste 3 :

the ratio was(0.5:1.5:1:0.5:0.5) from (rice (12.5gm) lentil (37.5 gm) cowpea (25gm) millet (12.5 gm) wheat (12.5gm)).from each one of those ingredient when you collect the amino acid (isoleucine) you found that in final ratio equal 6.68 in final product As shown in table 7.

R + L + C +M +W =P3 0.37+ 3.915+ 2.23+ 0.55+ 0.43=7.49

R= isoleucine ratio in 12.5 gm form rice .

L= isoleucine ratio in 37.5 gm form lentil.

C= isoleucine ratio in 25 gm form cowpea.

M= isoleucine ratio in 12.5 gm form millet .

W isoleucine ratio in 12.5 gm form wheat .

P3= pasts 3

Table (5) : Paste 1:

Acids / ingredient	Isoleucine	leucine	Lysine	Methounin	Phenylalanine	Threonine	Tryptophan	Valine
Rice	0.74	1.45	0.63	0.37	0.85	0.60	0.23	0.102
Lentil	2.61	4.61	4.34	0.48	3.66	2.40	0.57	3.02
Cowpea	2.23	4.11	3.99	0.68	3.02	2.20	0.63	3.06
Millet	1.1	2.37	0.725	0.775	1.3	1.05	0.375	1.65

Product Sigma	6.68	12.42	9.68	2.30	8.33	6.7	1.80	7.83
Meat	8.52	14.35	15.73	4.78	7.78	8.12	2.98	8.86

Table (6) : Paste 2

Acids / ingredient	Isoleucine	Leucine	lysine	Methouni n	Phenylalanine	Threonine	Tryptophan	Valine
Rice	0.37	0.725	0.315	0.185	0.425	0.3	0.115	0.051
Lentil	3.915	6.915	6.51	0.72	4.74	3.6	0.855	4.52
Cowpea	2.23	4.11	3.99	0.68	3.02	2.20	0.63	3.06
Millet	1.1	2.37	0.725	0.775	1.3	1.05	0.375	1.65

Product sigma	7.61	14.12	11.54	2.36	9.48	7.15	1.975	9.74
Meat	8.52	14.35	15.73	4.78	7.78	8.12	2.98	8.86

Table (7) : Paste 3

Acids / ingredient	Isoleucine	Leucine	Lysine	Methounin	Phenylalanine	Threonine	Tryptophan	Valine
Rice	0.37	0.725	0.315	0.185	0.425	0.3	0.115	0.051
Lentil	3.915	6.915	6.51	0.72	4.74	3.6	0.855	4.52
Cowpea	2.23	4.11	3.99	0.68	3.02	2.20	0.63	3.06
Millet	0.55	1.185	0.362	0.387	0.65	0.75	0.187	0.825
Wheat	0.43	0.805	0.227	0.175	0.585	0.307	0.116	0482

Product sigma	7.49	13.74	11.66	2.14	9.42	7.15	1.90	8.93
Meat*	8.52	14.35	15.73	4.78	7.78	8.12	2.98	8.86

3-2 Methods:

3-2-1 Paste preparation :

1- Remove the impurities (washing , sieving) from the material
2- Soaking the cowpea for 1 hours to facilitates the removable of hull
3- Weighting process
4- Boiling process lentil and rice in one utensil and cowpea in other utensil
5- Milling of millet and wheat
6- Mixing whole ingredient by using handed mixer (mafrma) .
7- For processing the paste now is ready to, use but you can dry it for long preservation.
8- Frizzing to preserve it in wet matter (-18 C)

This paste can be use for produce in different type of meat product (burger sausage negates…etc) and some functional foods.

3-2-2 production burger from the paste:

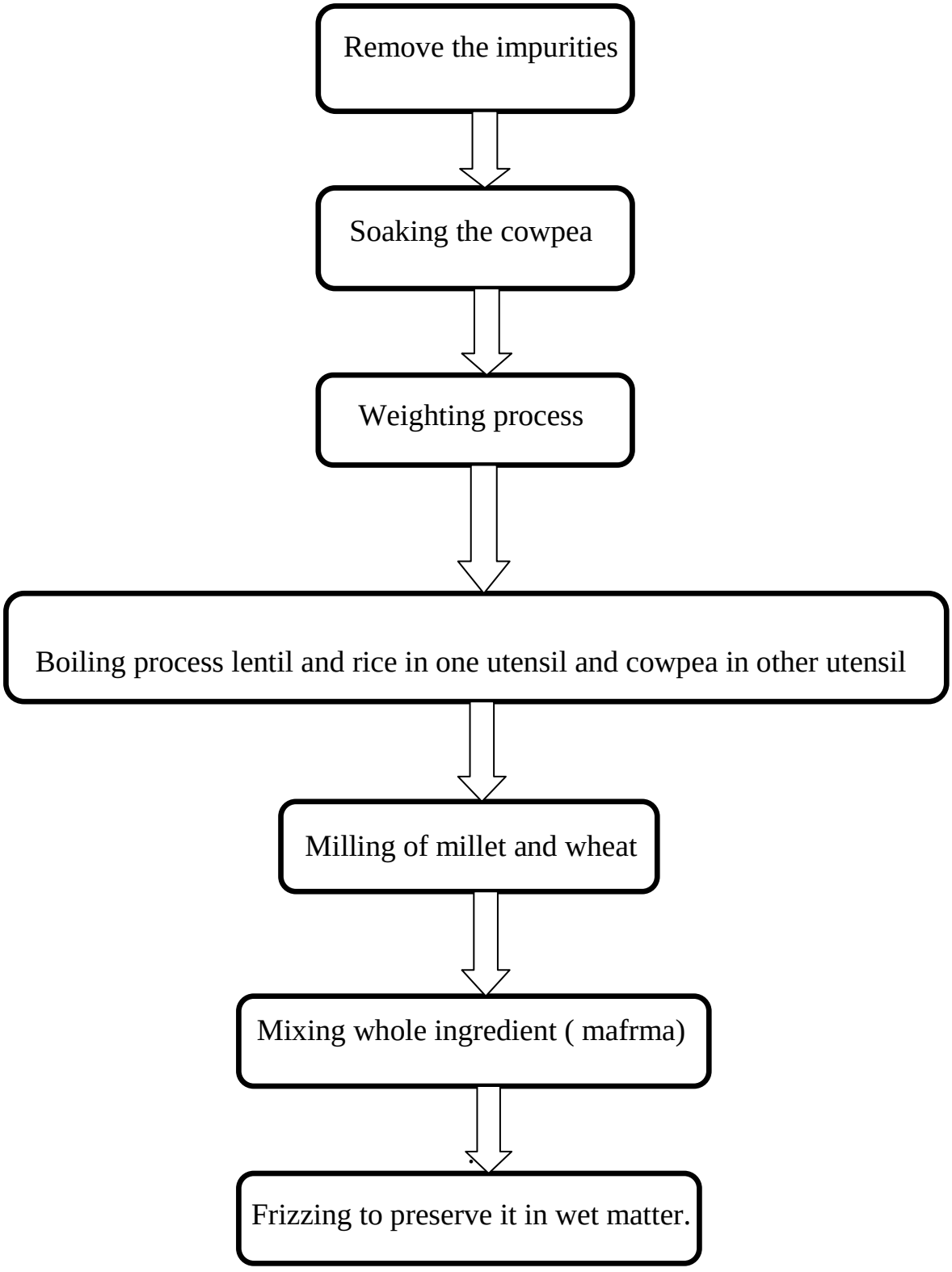
This paste it use as a base for producing burger instead

1- Burger paste preparation (additive : onions , tomato souse , species)

2-Mixing the additive and paste tougher by using meat grinder.

3- Forming the shape of the burger by using manual burger patty press

4-the burger is ready to consume after fried , but you can keep it by frizzing for long preservation .



Figer (2) : Paste preparation

3-3 Physicochemical analysis:

3-3-1 Moisture determination:

Moisture content was determined according to the Association of official's analytical chemists AOAC (1990) 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:

$$MC\% = \frac{(W2-W1)-(W3-W1)}{W2-W1} \times 100$$

Where:

Mc: moisture content,

W1: weight of empty crucible

W2: weight of crucible with the sample,

W3: weight after drying.

3-3-2 Ash content:

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 550c for 3hours or more until light gray ash was obtained. The crucible was removed from the furnace to a23desiccators to cool and then weighed. The crucible was reignited in the furnace and allowed to cooling until a constant weight was obtained. Ash content was calculated using following equation:

$$AC\% = \frac{W2 - W1}{W3} \times 100$$

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:

1/ Digestion:

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 H2SO4was 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.

2/ 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 containing10ml of 2% boric acid plus 3-4 drops of methyl red indicator. The distillation was continued until the volume reached 50 ml.

3/ 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;

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

Ws x 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 follows:

An empty clean and dry exhaustion flask was weighed. About 2 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 8 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:

$$FC\ (\%) = \frac{W2 - W1}{\_\_\_\_\_} \times 100$$

Ws

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 H_2SO_4 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:

$$CF\ (\%) = \frac{W1 - W2}{Ws} \times 100$$

Where:

CF = Crude fiber

W1 = Weight of crucible with sample before ashing

W2 = Weight of crucible with sample after ashing

Ws = weight of sample

3-4 Sensory evaluation

Cooked burgers were cut into pieces of uniform size and served worm to twenty judges of student of college of agriculture studies Sudan University for since and Technology semi trained according to procedure of ranking scores. Sample were coded and presented in randomized order The judges evaluate the attributes of color flavor taste tenderness and over all acceptability by the mean of scale.

3-5 Statistical analysis:

Analysis of variance was preformed to examine significant difference between sample of replicated measurement .probability level of less 0.05 was considered significant ($p<0.05$) . all data were analyzed using statistical 8 statistical software .

CHAPER FOUR

RESULTS AND DISCUSSION

4-1 Physicochemical composition

4-1-1 Moisture content:

Moisture content for paste1,2,3 was (75.3 , 60, 53.92 respectively) as shown the first paste has a higher moisture content than paste 2,3 this due to reducing of rice in paste 2 and 3 which lead the carbohydrate , and the Moisture content of 2 is higher than 3 this may be due reducing the millet in paste 3.

4-1-2 Ash:

The ash content in paste 1,2,3 was (2.77 ,2.93, ‘2.84 respectively) as shown the paste 1 is lower in ash content than paste 2,3 this due to increasing lentil , and paste 3 is lower than paste 2 , may be this due reducing the millet in paste 3.

4-1-3 Crude fat:

The fat content in paste 1, 2, 3 was (4.51, 3.4, 4.19 respectively)the paste 1 is lower than paste 2 this due to reducing of rice in paste 2,3 and paste 3 is higher than paste 2 ,1 due to adding wheat .

4-1-4 Fiber content:

The fiber content in paste 1,2,3 was 1.51, 3.59, 4.33 respectively) the increase from paste 1 to 3 is due to increase of moisture content also this due to increase of lentil in 2 , and the increase from paste 2 to paste 3 is due to addition of wheat in paste 3 .

4-1-5 Protein content:

There clearly increase of protein from burger of paste 1 to burger from paste 3 and this general according to our treatment in paste 1 to get it in higher content of protein and the lentil has the basic effect in this ratio, the different between paste 1 and 2 in protein is very high in compare to the different between paste 2 and 3 also this from the different between lentil ratio in burger from paste 1 and 2, and the

simple variation between burger from paste 2 and 3 in protein content this due to addition of wheat in paste 3, not only this but also the final product is similar to meat in essential amino acids.

Table (8) : Physiochemical composition (%) of different type of burger:

Sample	Ash	Fiber	lipid	MOITURE	PROTIEN
A	2.7700^{c} ±0.0300	1.5100c ±0.1300	4.5100a ±0.1300	75.287a ±0.3802	14.817c ±0.6144
B	2.9300^{b} ±0.0100	3.5867^{b} ±0.0451	4.1900b ±0.1900	60.000b ±1.1900	18.510b ±0.1500
C	2.8400^{a} ±0.0100	4.3267^{a} ±0.1050	3.4000c ±0.0100	53.920c ±0.3100	19.490a ±0.0800

Mean ± SD All 3 means are significantly different from one another (P 0.05).

A = burger from paste 1.

B = burger from paste 2.

C = burger from paste 3.

4-2 Sensory evaluation:

As shown in table 9 sensory evaluation revealed that there was significant different in color except C ,

flavor no significant different except A ,

taste no significant different except texture no significant different in A and C but there significant different in B and D

overall acceptability no significant different except A .

Table (9): Sensory evaluation of different types of burger:

sample	Color	Flavor	Taste	Texture	Overall Acceptability
A	3.4500[b] ±0.7592	2.9500[b] ±0.8870	2.7500[b] ±1.1642	2.9500[b] ±1.1910	2.6000[b] ±0.8826
B	2.6500[c] ±0.9333	2.7000[b] ±1.1286	2.4500[b] ±1.0990	2.2500[c] ±0.9105	2.3000[b] ±0.8013
C	3.6000[ab] ±1.2312	3.0000[b] ±1.0761	3.1000[b] ±1.2096	3.1500[b] ±1.0400	2.9000[b] ±1.2096
D	4.1500[a] ±0.8751	3.8500[a] ±0.9333	4.4000[a] ±1.0463	4.4000[a] ±0.8826	4.1000[a] ±1.0208

A= burger from paste 1.

B = burger from paste 2.

C = burger from paste 3.

D = meat burger 4.

CHAPER FIVE

CONCLUSIONS AND RECOMMENDATION

5-1 Conclusions:

From this study one can conclude that :

1-The product chemical composition of burger form different pastes showed a high significant difference (p 0.05) .

2- Sensory evaluation showed that there is significant difference in color between all sample, and no significant difference in flavor , taste and overall acceptability except sample D, in texture no significant difference between sample (A , C) .

3-Generally burger of sample C found to be the best than sample A and B and similar to sample D which is meat burger .

5-2 Recommendations:

According to the importance of protein for human being.

1-introduction of the product as paste can be followed in meat industry as additive instead of other unnutritive additive (skin, lard ….etc)

2-We recommend eating the product from this paste to avoid the health problem form eating meat (e.g. Gout , hypertension).

3-From this study it's possible to provide the body requirement of protein from cheap food sources.

4-We recommend making lab analysis of essential to be more confidence about the protein efficiency ratio in the product.

5-We also recommend the Sudanese must retain as much as possible to their old tradition meals in which there is mixing between legumes and cereals such as eating cowpea relishes (mullah al luba) with millet porridge.

6- Furthers studies are recommend to use other sources of plant (bean nut, soy bean …. etc) .

REFERENCES

FAO Nutritional Studies , Amino Acid Content of Foods and Biological Data on Proteins (1970). No. 24. Rome: Food and Agr. Organ.

Aykroyd, W.R, and J.Doughty (1964) Legumes in Human Nutrition FAO Nutritional Studies No.19 Rome: food and Agr Organ.

Bressani, R.O.W Nilson, M. Behar, and N.S .Scrimshaw (1960) Supplementation of cereal proteins with amino acids, Effect of amino acid supplementation of wheat flour as measured by nitrogen retention of young children .J . Nutrition .

Eva. D. Wilson , Kacherine H. Ficher , Pilar A.Garcia (1979).principle of nutrition published in Canada .

Food and Agriculture Organization / World Health Organization (1971). FAO Nutrition Meetings Rept. Series No. 49. Eighth Report. Rome: Food and Agr. Organ.

Hegsted , D. M. (1973). The amino acid requirements of rats and human beings. In Proteins and Human Nutrition, edited by J. W. G. Porter and B. A. Ralls. New York: Academic Press ». 275.

Linda Johnson Larson. B .S (2012) food science and nutrition Cook Book USA

Jansen G.R , (1977) Amino acid fortification . In Evaluation of protein for Humans edited by C.E Bodwell Westport , Conn : Avi publ .Co,

APPENDICES

Appendix(1): burger from Paste 1

Appendix(2): burger from Paste 2

Appendix(3): burger from Paste 3