بسم الله الرحمن الرحيم

الآية

قال تعالى :

(واية لهم الأرض الميتة احييناها واخرجنا منها حبا فمنه يأكلون (33)وجعلنا فيها جنات من نخيل وأعناب وفجرنا فيها من العيون (34)ليأكلوا من ثمرة وماعملته ايديهم أفلا يشكرون (35)سبحان الذي خلق الأزواج كلها من ماتنبت الأرض ومن أنفسهم ومن ما لا يعلمون (36)

صدق الله العظيم

سورة يس الأيات (36 -33)

DEDICTION

THIS WORK IS DEDICATED TO

OUR DEAR PARENTS

OUR FAMILIES

ALL FRIENDS

OUR TEACHERS

SPECIAL THANK FOR OUR DEAR SUPERVISOR:

DR. BARAKA MOHAMMED KABEIR

الأهداء

فلتشهد الأزمان أنك يا أبي كالنيل تعطي طائعا مختارا تسبيحه في الفجر أسمك يذكر كالتاج في رأسي حملت فخارا

الى من حصد الأشواك عن دربي ليمهد لي طريق العلم

إليك مصدر فخري .....كفاني فخرا ان تكون انت ....

إليك أبي

في حضنك الدافي دفنت مخاوفي ووجدت في تحنانك إستقرارا

ترنيمتي ارجوحتي انشودتي ...أمي ونور العين والأبصار

إلى بسمة الحياة وسر الوجود ....الى من كان دعاؤها سر نجاحي

وحنانها بلسم جراحي ...الى أغلى الحبايب...

إليك أمي

الى عبق الماضي المتفرد ودفء الانتماء الأخضر ضد الازمنة القادمة ...

اليكم أخوتي

الى كل من اتخذ العلم جوادا يمتطيه ليقطع به درب المعرفة الشائكه وينهل من معينها

الثر ...

اليكم زملائي

الى من لم اعرفهم ولن يعرفونني ..الى من اتمنى ان اذكرهم حين يذكرونني ....

الى من ستبقى صورهم في عيوني ...

الى الجميع

ABSTRACT

The growth of *Bifidobacterium longum*BB536and its related physiochemical change during fermentation of potato thin porridge beverage were evaluated. Potatoes were primary washed**,** peeled, sliced and dried in oven at 40˚ C for 24 hour .The dried sliced were ground into flour by hammer mill**.** 50g of potato powder was blended with 450 ml distilled water for 5 min**.** The resulting mix was added slowly to glass beaker containing 500ml boiling water on hot plate and cooked with continuous stirring for 10 min. After cooling 10 g malted sorghum flour were and sterilized at(121˚c for 15 min**,**30 ml of sterile fresh milk was added to the mix , and aseptically inoculated with(3% v/v*)Bifidobacterium longum* BB53 followed by fermentation at 37˚c for 72 hours .Samples were collected at 6 hours interval for analysis**.** The results obtained indicated that there was increase in *Bifidobacterium longum*BB536 viable number by extended fermentation in all types of fermented beverages .The rate of increases were 1.5 ,1.3 1.83 log CFU/ml in potato beverage, mix and fresh milk respectively. There was decrease in moisture ,pH, TSS content by fermentation in all types of fermented beverages. The viable number of *B. longum*BB536 at 18 h fermentation in all types of fermented beverages fulfills the number required to presence in Probiotic product which was at least 6 log CFU/ml. Therefore, fermented potato thin porridge is suitable carrier for *Bifidobacterium longum* BB536 as compared to fresh cow milk**.**

ملخص البحث

تم تقييم نمو البكتريا الصد يقه *Bifidobacterium longum* BB536 **والتغيرات الفيزوكيميائيه المصاحبة أثناء تخمير مديدة البطاطس. تم غسل البطاطس وتقشيرها إلى شرائح ومن ثم تجفيفها في فرن درجة حرارته °40)م لمدة 24ساعة . (شرائح البطاطس المجففه تم طحنها باستخدام الطاحونة اليدويه .تم خلط 50جم من بدرة البطاطس مع 450مل من الماء المقطر لمدة 5دقائق ,تم إضافة المزيج الناتج إلي 500مل من الماء المغلي وتم طبخه بالخلط المستمر لمدة 10دقائق .بعد تبريد المزيج الناتج تمت إضافة 10جم من دقيق الذرة المنبت)الذريعة, (ثم تعقيم المزيج في درجة حرارة 121م° لمدة ربع ساعة, (تمت إضافة 30مل من اللبن المعقم ومن ثم إضافة 3%)ح/ح (من بادئ البكتريا الصديقة** *Bifidobacterium longum* BB536 **والتخمير في درجة حرارة 37م° لمدة 72ساعة.تم أخذ العينات كل 6ساعات للتخمير.أشارت النتائج التي تم الحصول عليها إلي إن هنالك زيادة في عدد البكتريا الصديقة باستمرار عملية التخمير في كل أنواع المشروبات المخمرة** 1.5 , 3.1, 1.83 log CFU/ml **في مشروب البطاطس ,الخليط واللبن الطازج علي التوالي .هنالك انخفاض في محتوي الرطوبة** pH**, والجوامد الصلبة الذائبة باستمرار عملية التخمير في كل أنواع المشروبات المخمرة عدد الخلايا الحية لبكتريا** *Bifidobacterium longum* BB536 **عند تخمير عند أنواع المشروبات لمدة 18ساعة يفي بالعدد المطلوب وجوده في منتجات البروبايتوك والذي يجب ألا يقل عن** 6log CFU/ml **. لذلك مديدة البطاطس المخمرة حامل مناسب لبكتريا** *Bifidobacterium longum* BB536 **مقارنة بلبن البقر الطازج.**

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CHAPTERONE

1:1 INTRODUCTION:

Potato has a great importance as food for human .It has different ways of consumption .It contains carbohydrates formed in starches constitute the main part of the dry matter (10.96 - 22.13%) .Although the potato has lower percentage of protein it is of very good quality. Potato is also major source of essential vitamins needed by the human body, However methods of storage effects quality leading to deterioration of potatoes (Volkind , *et al*., 2004). There are hundreds potato variety classified in to 12 groups. Potatoes are grown widely throughout the world although the varieties used and the amount produced varies greatly (Mac Gillivray, 1961).Nutritional value of potatoes is less but it is a good source of iron .potato also provide 45% of the Recommended Dietary Allowance (RDA) of vitamin C , 8% of the RDA for iron and 2% of the calcium (Decoteau, 2005). Potatoes are served baked boiled mashed ,or roasted and as French fires shoe-staring chips and how fries potatoes are served whole , canned or scalloped and use in soup , stew, chowders and dumplings .They are also used in hot and cold potato salad ,processing potatoes are dehydrated, flaked and granulated and used instant mashed. potatoes are being used more as processed product and less as fresh commodity . (Decoteau,2005). Fermentation could play vital role in improving overall quality of potato . furthermore with the used of Probiotic extra functional properties could be important to potato based product. Probiotics are microbial feed to more beneficial supplement that modify intestinal microbial balance to more beneficial effect. The preparation of thin porridge is very simple .Small quantity of sour or un fermented dough is mixed and boiled, with continuous stirring in a large amount of water .However ,there are various kind of thin porridge.(Culwick,1951) .The word Easley flowing thin porridge has largely replace the word thin porridge in urban areas . Generally speaking nasha denotes a thin porridge and refined thin porridge that is prepared in particular for the sick and the fasting. Easley flowing thin porridge seems to denotes more a fermented porridge while thin porridge may either be fermented or un fermented (El-Gendy1983). The primary difference between Easley flowing thin porridge and thin porridge should be taken as the difference

between two methods of thin porridge preparation: The one involving decantation and the one that does not the best thin and refined Easley flowing thin porridge is that produced via a method of decantation. A second decantation is then carried out very carefully the process is repeated until practically no more precipitate forms. Easley flowing thin porridge is made from the final supernatant i.e. from the 7extract of a jin about three parts of the original four of the suspension are covered as supernatant extract to be turned in to Easley flowing thin porridge by cooking while continuously stirring the consistency of the product is adjust by either adding a little more water or by evaporating of excess water by heating for a longer period. The African thin porridge are all consumed by healthy as daily food . Easley flowing thin porridge and thin porridge are traditionally prepared for three major target groups. Chemical analyses of dabar thin porridge shed that the product contained 95% water 3.2% starch 1.3% crude protein 0.3% crude fiber 0.4% ash 0.2% fat and 230 calories per 100g (MonawarandBd1987).The thin porridge could be made from sorghum, millet and wheat flower. However vegetable based thin porridge is not available in Sudan but it is available in some African countries, Among the vegetables potato is widely produce in Sudan.

Objectives of this study are :

1\ To determine the proximate composition of potato.

2\ To evaluate the growth of *Bifidobacteriumlongum*BB53 on potato beverage.

3\ To determine the effect of fermentation with bifido on physiochemical composition of the fermented potato.

CHAPTER TWO

LETERATUREVIEW

2:1 Potato

2:1:1 Scientific name of potatoes

Solanum tubersum

2:1:2 Origin of potatoes

The probable origin of potato *Solanum tuber sum* is in South American . and introduced into England in 1586 .Following its introduction in to agriculture, potatoes become an importance food crop worldwide (Bhardwaj,2004).

2:1:3 Nutritional value of potatoes:

Potato contains 77% water per100gm. The edible portion provide energy (85 calories) , protein (2.0gram) , calcium(13 mg) ,ascorbic acid (12 mg) ,thiamine (0.11mg), riboflavin(0.06 mg) and niacin (18mg).

2:1:4 Environmental requirement for potato quality:

Temperature is an important factor in potato production,and principal production areas are characterized by cool weather, average mean temperatures of 60 - 65 F are perfect for tuberization , The best growth tuberization is at soil temperature of 64.Tuberization rate of potato decreased at 68, and inhibited at 84F.Higher temperature, long days, and abundance of nitrogen favor the growth of all plant parts except tubers. Nevertheless, lower temperature and deficient of nitrogen cause early tuberization (Mac Gill vary, 1961).

2:1:5 Storage of potato:

Cooking quality, palatability, and composition of potatoes are influenced markedly by the storage temperature, Potatoes exposed for several weeks to a temperature just above freezing turn sweet because starch is converted to sugar. At 60 - 70 temperature excess/ sugar is removed primarily by respiration. In fact the tuber should have adequate ventilation to prevent the occurrence of black heart .After potatoes have been stored for several months the eyes tend to produce sprouts which cause the tuber to wither (Mac Gill vary, 1961).

2:1:6 Infestation by insects:

Once emerged, potatoes are susceptible to cut worms flea beetles, and leaf pets, potatoes beetles is a major problem as adult dormant over winter in soil and emerge about the same time the potatoes are emerging .The beetles feed on young foliage and deposit eggs on the leaves .while the flea can cause extensive defoliation they can be controlled with systemic soil in cides foliar sprays or appropriate crop rotations. Potatoes field planted after hosts (peanuts, whet, and sorghum .etc) have fewer beetles' problems than field planted with potatoes the previous year (Decoteau, 2005).

2:1:7 Diseases:

common fungal problems of potato foliage are early blight tern aria, fusariume wilt ,and verticillium wilt .Blackleg, bacterial disease is acterized by blackening of the stems and yellowing curling of leaves .Afusarium species and blackleg bacterium can cause tuber rotes. Rhizoctonia forms black sclerotria on the surface of the tubers , another fungal disease of the tuber surface is the common scab Streptomyces (Decoteau,2005). Using fresh potatoes for production of/ dried potato products is of potential .It could be stored for long period at time fermentation of potato can also be used to produce an alcoholic beverage (price ,1987).

2:2 Milk:

Milk is white liquid of mammary gland of mammals. It is the primary source of nutrition for young mammals before they are able to digest other type of food. Early - lactation milk contains colostrums, which carries the mothers antibodies to its young and can reduce the risk of many diseases. Milk contains many other nutrients and the carbohydrate lactose, (Pehrsson2003). As an agricultural product, milk is extracted from mammals during or soon after calving and is used as food for humans.

2:2:1 Sources of Milk:

The females of all mammals species can by produce milk , but cow's milk dominates commercial production . In FAO ,2011 estimates 85% of all milk worldwide was produced from cows.

2:2:2 Usages of milk:

Besides serving as a beverage or source of food, milk has been used by farmers and gardeners

Table (1): Average composition (%) cow milk

Main constituents	Average (%)	Mean (%)
Water	85.5-89.5	87.5
Total solid	10.5-14.5	12.5
Fat	2.9-5.0	3.9
Protein	1.5-6.0	3.8
Lactose	3.6-5.5	4.6

Source: FAO (2011)

2:2:3 Benefits of milk and milk components:

1/ Helps reduce risk of colorectal (colon) cancer.

2/ Helps maintain healthy bones.

3/ Helps reduce the risk of high blood pressure (hypertension).

4/ Helps reduce the risk of some cancers.

5/ Helps maintain a healthy weight.

6/ Reduces the risk of heart disease and stroke.

2:3 Probiotic

2:3:1 History of Probiotic

In the late 19th century, microbiologists identified microflora in the gastrointestinal (GI) tracts of healthy individuals that differed from those found in diseased individuals. These beneficial microflora found in the (GI)tract were termed Probiotic. Probiotics, literally meaning' for life', are micro-organisms proven to exert health benefit in humans and animals (Marteau *et al*.1995).

2:3:2 Definition of Probiotic:

Are usually defined as microbial food supplements which beneficially effect the consumers heath .Most Probiotics fall into the group of organisms known as lactic acid -Producing bacteria and are normally consumed in the form of yogurt, fermented milks or other fermented foods.

2:3:3 Some beneficial effect of lactic acid bacteria consumption includes:

1-Improving intestinal tract health

2-Enhancing the immune system, synthesizing and enhancing the bioavailability of nutrient

3-Reducing symptoms of lactose intolerance, Decreasing the prevalence of allergy in susceptible individuals
4-Reducing risk of certain cancers.

2:3:4 The role of Probiotics in dairy fermentations is to assist in:

1/ The preservation of the milk by the enervation of lactic acid and possibly antimicrobial compounds
2/ The production of flavor compounds (e.g. acetaldehyde in yoghurt and cheese) and other metabolites (e.g. extracellular polysaccharides) that will provide a product with the organoleptic properties desired by the consumer
3/ To improve the nutritional value of food, as in, for example, the release of free amino acids or the synthesis of vitamins
4/The provision of special therapeutic or proplytic properties as cancer (*Reddy et al*. 1973, *Fernandes et al*. 1987, *Gilliland* 1990, *O'Sullivan et al*. 1992) and control of serum cholesterol levels(*Lin et al*. 1989

Potential benefits may result from growth and action of the bacteria during the manufacture of cultured foods (*Shuhimi* and *Ayebo* 1980). Atherapeutic benefit also includes proplytic in effect against some types of intestinal infection (*Fernandes* et al. 1987), improved digestion of lactose against lactose maldigestion lactose-containing foods (*Sawada et al*. 1990). Lactose absorption may compromise their intake of protein and calcium (*Saavedra et al*. 1994, *Saikali et al*. 2004) and these micro flora are capable of providing numerous health benefits beyond basic nutritional value (*Alm* 1982, *Hosono* 1986, *Benchimol* and *Mack* 2004).

2:3:5 Probiotics preparation:

The most commonly used organisms in probiotic preparations are the lactic acid bacteria these are found in large numbers in the gut of healthy animals and are in the words of the America FDA, Generally Regarded as Safe. Organisms other than lactic acid bacteria, which are currently being used in probiotic preparations, include Bacillus sp., yeasts (e.g. Saccharomyces cerevisiae and Saccharomyces boulardii) and filamentous fungi (e.g. Aspergillus oryzae) Probiotic products are now available in different formulations with *L. acidophilus*, *B. longum*, *Bifidobacterium* infant is, *Enterococcus fusariume* and others with or without Probiotic and fructose oligosaccharides (FOS). Some of the most common probiotic products are *L. acidophilus* with FOS, L.acidophilus and Bifidus longum with FOS, and Bifidus infants and *L. acidophilus* with FOS. these probiotic preparations may be presented in the form of powders, tablets, capsules, pastes or sprays depending on the animal or human receiving the supplement and the condition to be treated.

2:3:6 Health benefit and therapeutic effects of Probiotics:

There are a variety of proposed beneficial health effects of Probiotics Clinical symptoms that have been reportedly treated or have the potential to be treated with probiotics include diarrhea, gastroenteritis, irritable bowel syndrome, and inflammatory bowel disease (IBD; Crohn's disease and ulcerative colitis), cancer, depressed immune function, inadequate lactase digestion, infant allergies, failure-to-thrive yperlipidaemia,hepatic diseases, Helicobacter pylori infections, and others. The use of probiotics should be further investigated for its possible benefits and its side-effects (*Bengmark* 2000, *Benchimol* and Mack 2004, *Brown* and *Valiere* 2004).

2:3:7 Application of Probiotic in food:

- Yogurt

- Kefir
- Aged cheeses
- Kimchi
- Sauerkraut
- Miso
- Tempeh
- Some soya beverages.

There are also products available which are probiotic-fortified such as juices, chocolates, flour and cereal.

2:3:8 Bifido bacterium Scientific Classification

Bacteria Kingdom

Actinobacteria Phylum

Actinobacteria Class

Actinobacteridae Subclass

Bifidobacteriales Order

Bifidobacteriaceae Family

Befidobacterium (oral-Jensen 1924) Genus

The most commonly used species of lactic acid bacteria in probiotic preparations as shown in (Table 2)

Lactobacillus	Bifidobacterium	Entercoccus	Streptococcus

sp	**sp**	**sp**	**sp**
L. acidophilus	**B. befidium**	**Ent. Faecalis**	**S. cremoris**
L. casei	**B. animalis**	**Ent. Faecium**	**S. salvarius**
L. delbrueckii ssp	**B. infantis**		**S. diactylactis**
L. cellobiosus	**B. longum**		**S. intermedius**
L. curvatus	**B. thermophilum**		
L. fermntum	**B. adolescentis**		
L. lactis			
L. plantarum			
L. reuteri			
L. brevis			

2:4 Definition of fermented food :

Campbell Platt(1987) has defined fermented foods as those foods which have been subjected to the action of microorganisms or enzymes so that desirable biochemical changes cause significant modification to the food . However to the microorganisms or fermentation describes a form of energy _ yielding microbial metabolism in which an organic substrate usually a carbohydrate is incompletely oxidized and as organic carbohydrate acts as the electron acceptor. This definition means that processes involving ethanol production by yeast or organic acid by lactic acid bacteria are considered as fermentations but not the production of fish sauces in southeast Asia that still has not been show to have a significant role for microorganisms and not the temp production since the metabolism of the fungi is not fermentative according to Adams definition .whichever definition used , food submitted to the influence of lactic acid producing microorganisms is considered a fermented food .

2:4:1 Safety of fermented food :

The WHO food safety unit has given high priority to the research area of fermentation as technique for preparation / storage of food . One main reason for this is that in developing countries, one tenth of the children

under five years of age dies due to dehydration . The dehydration is mainly caused by incidences of diarrhea . The main cause for getting diarrhea is ingestion of food not having the appropriate standard regarding the hygienic condition . The hygienic standard of food is based on the processing and handling of the food as well as on the condition of the raw material . A food item prepared from water contaminated Lactic acid fermentation of food has been found to reduce the risk of having pathogenic microorganisms grow in the food (*Campbell_ plat,1987*)

2:4:2 Benefits of fermented food

The benefit of food fermentation as compiled by (*Dirar*, 1993) is shown in (Table 3) .

Table(3): The benefits of food fermentation (from Dirar,1993)

Raw material	**Stability**	**Safety**	**Nutritive value**	**Acceptability**
Meat	++	+	_	**(+)**
Fish	++	+	_	**(+)**
Milk	++	+	**(+)**	**(+)**
Vegetable	+	**(+)**	_	**(+)**
Fruits	+	_	_	++
Legumes	_	**(+)**	**(+)**	+
Cereal	_	_	**(+)**	+

(++)Definite improvement .

(+) Usually some improvement .

(+) Some cases of improvement .

(_) No improvement.

Many fermented milk product which are eaten as they are contain living microorganisms . Acidophilus milk yoghurt and kefir are fermented milk containing either lactic Acid bacteria(LAB) alone or both LAB and yeast or mixed cultures producing mainly lactic Acid or a combination of lactic acid and small amounts of alcohol . Kumis is fermented milk made of mares milk using a mixed culture . Lassi in India fermented milk consumed as a beverage after dilution with water and Yakult in Japan and

China are typical fermented milk products made of mixed culture by spontaneous fermented .Other milk based products which are fermented with some cereals are flummery which is fermented yoghurt like product containing boiled whole grains and prokllada which is mainly fermented whey with addition of taste enhancing substances . Lao_chao a fermented glutinous slightly alcoholic steam cooked rice maheu a non_alcoholic beverage frame maize sorghum and or millet pozol which is either a thick porridge like food or a thin beverage made of maize flour. A thick alcoholic beverage similar to beer made of sorghum. A thick pasty fermented food containing alcohol made from millet or maize but also some times from cassava are typical example of fermented foods made of cereal. food like injiera from tef and kissra from sorghum are commonly made after fermenting dough for two or three days with or without starter. The common fermented legume products include hama_natto which is a soybean paste used for flavoring, made of groundnut press cake or soybean press cake used as a relish fermented soy milk and of soybean curd mould salt and alcohol . Kimchi is a popular fermented food made mainly of vegetable in Korea .Pickled fruits and vegetable are common in many countries and sauerkraut is a well known product made by fermented cabbage. German salami (smoked) Italian salami Lebanon (sausage) loganiza (sausage) and Teewurst are typical fermented meat product of Europe. While peak made of fish and cereal by lactic acid fermentation and pin dang and tarama made of fermented roe are typical fermented fish products of the Far Eastern countries.

CHAPTER THREE

MATERIAL AND METHODS

3:1 Raw material:

Fresh Potatoes were purchased from local market in Omdurman Town(Khartoum state, Sudan). Potatoes were primary washed ,peeled, sliced and dried in oven at 40˚Cfor 24 hours the dry sliced were ground in to flour by hammer mill and sieved through 500mm screen. 500g of potato powder was blended with 350 ml distilled water for 5 min . The resulting mix was added slowly to glass beakers(one litter) containing 500ml boiling water on a hot plate and cooked with continuous stirring for 10 min . After cooling 10g malted flour was added ,then 30ml of sterile fresh milk was combined. the mix was aseptically inoculated with *Bifidobacterium longum* BB536 followed by fermentation at 37˚C for 72 hours. Samples were collected at 6 hours interval for analysis.

3:2 Malting of sorghum:

malting of sorghum was carried out according the method of (*kabeir*, 2005). Cleaned sorghum was washed twice with water and soaked for 12,24,36 and 48 hours to allow maximum absorption of water. The water was renewed every 6 hours during the soaking period to avoid any changes by fermentation .For germination ,the soaked sorghum was spread on aluminum foil and incubated at room temperature for 3 days. During the germination period ,the sorghum was turned and rinsed every 6hours with water to promote aeration and prevent mould development. sorghum soaked for 48 hours and malted for 3 days was dried in the sun for 48 hours . After that the roots were removed and the remaining portion of the sorghum was ground into flour by hammer mill and sieved though 250mm screen to obtained the malted flow.

3:3 Preparation of starter culture

Bifidobacterium longum BB536 from the stock of culture microbiology laboratory of Department of food science Collage of Agricultural studies Sudan University. The Bifidobacterium longum BB536 culture was regenerated by transferring into 20%sterilized (121c for 15 min) fresh milk and incubated at 37˚C for 24 hours. The regenerated culture was further sub-culture into 10% sterilized (121c for 15min) fresh milk. The stock cultured was produced by inoculating the last culture in 20%sterilized fresh milk followed by an aerobic incubation as described before. These last cultures were used in fermentation process.

3:4 Fermentation of dried potato

Potato was fermented as shown in figure (1). Dried potato powder (50g) was blended with 450ml distilled water for 5 min. The resulting mix was added slowly to glass beaker (one litter) containing (500) ml and cooked on a hot plate with continuous stirring for 10min. After cooling, 20g malted flour was added to mix, which sterilized (121˚c for 15min) and aseptically incubated with *befidobacterium longum*BB536 followed by Fermentation at 37˚C for 72 hours. Samples were collected at 6 hours interval for analysis.

Fermentation potato thin Porridge.

(50g) of dried potato blended with (450ml) distilled water

The mix was added to (500ml) boiling water on hot plate and cooked for 10 min

↓

(30g) fresh milk and (20g) malt was added to mix during cooked

↓

The mixture was sterilized at(121˚C for 10 min) on water bath

↓

Cooling the mixture and inoculated with 3%(v/v) *Bifidobacterium longum* BB536

↓

Incubated for 3 days

Figure (1) flow diagram fermentation potato thin Porridge

3:5 Total viable count:

MRS was used for enumeration *B.longum*BB536 of fermented thin porridge using the plate count technique .Samples were drawn at initial and every 6h intervals during fermentation . 1ml of fermentation broth was diluted in peptone water , followed y plating on Rogosa a gar (MRS).

The plates were incubated an aerobically at 37˚C for 24h.Growth was calculated as colony forming Unit (CFU/ml).

3:6 Moisture

The moisture content was determined according to the standard method of the Association of official analytical chemists (*AOAC*, 2005).

Procedure:

In a clean dry dish sample of 5gm dried Potatoes slice was weighted and place on oven at 105˚C, the oven switched on for 6 hour or until consistent weight was obtained. The dried sample were transferred to desiccators and cooled each samples to room temperature, tow reading were obtained for each sample and the mean value was reported.

Calculation:

$$\text{Moisture content (\%)} = \frac{(Ws - Wd)}{\text{Sample weight (g)}} \times 100\%$$

Where:

W1: weigh of dish + sample before drying.

W2: weigh of sample after drying

S: weigh of sample.

3:7 Crude protein content:

The crude protein was determined according to the method of the association of official analytical chemist (*AOAC*, 2005).

Procedure:

5 gram of the sample was accurately weight and transferred together with the catalysts mixture in to kjeldhal flask was added. The flask was placed into akjeldhal digestion unit then left to cool at room temperature. 60ml of sodium hydroxide 45% was added. The distillation of ammonia was carried out in 20 ml boric acid (2%) until blue color was obtained. Finally the distillate was titrated with the standard solution of HCL (0,1N) until peal pink color appeared.

Calculation:

$$\text{Crude Protein (\%)} = \frac{(\text{ml Hcl sample} - \text{ml Hcl blank}) \times N \times 14.00 \times F}{\text{Sample weight (g)} \times 1000} \times 100\%$$

3:8 Fat content:

Fat content was determined y soxhlet method according to the procedure of the association of official analytical chemist (*AOAC*2005).

Procedure:

5gm of sample was weighted in the extraction thimble and covered with cotton. A moderate a month of organic solvent was added and boiled adjusting the heart source, the evaporated solvent drips from the condenser into the extraction flask. The extraction was continued for 6 hours. After that the round bottle with the extract was placed in an oven at 102c for drying to a constant weight. The bottle was cooled in desiccators and weight.

Calculation:

$$\text{Fat content (\%)} = \frac{(W2 - W1)}{W3} \times 100$$

3:9 Determination of ash content:

It determined according to method of the association of official analytical chemists (*AOA* C,2005) .

Procedure:

5 gm of the sample was weighed and placed into a pre-heated cooled and weighed porcelain crucible and then transferred into a muffle furnace at 550˚Cto 600c until white gray ash was obtained the crucible was placed in to desiccators and allowed to cool at room temperature and then. The

obtained weight was calculated as a percentage based on the dry matter content of the sample.

Calculation:

$$\text{Ash (\%)} = \frac{[(\text{Wt of crucible} + \text{Ash}) - (\text{Wt of empty crucible})]}{\text{Initial weight (Wt)}} \times 100$$

3:10 Determination of crude fiber:

Tow grams of an air dried fat free sample were transferred to dry 600 ml beaker. The sample was digested with 200ml of 1.25% (0.26n) sulphuric acid for 30 minutes , and the beaker was periodically swirled the contents were removed and filtered through Buchner funnel , and washed with boiling water . The digestion was repeated using 200 ml of 1.25 %(0.23N) NAOH for 30 min . And treated similarly as above. After the last washing the residue was transferred to ashing dish, and dried in an over at 105c overnight then cooling and weighed. The dried residue was ignited in muffle furnace at 55c to constant weight, and allowed to cool , and then weighed . The fiber percentage was calculated as follows:

Calculation:

$$\text{Crude fiber (\%)} = \frac{(W1 - W2)}{\text{Sample weight (g)}} \times 100\%$$

3:11 Determination of Carbohydrates:

Carbohydrates were calculated by difference.

Total carbohydrates without fiber = (100- (Ash% + Moisture% + CP% +Fat% + Fiber %)

3:2 Determination of total minerals:

Minerals were extracted from the sample by dry ashing method . The amount of iron Ca and Cu were determined using atomic absorption spectroscopy (*perken - Elmer* 2380). Ammonium van date was used to determined phosphorus along with ammonium molybdate methods of the

association of official analytical chemists (*AOAC*, 2005).Sodium and potassium contents were determined by flame photometer according to

(*AOAC*, 2005).

3:2:1 Potassium contents:

Potassium contents of extracted sample were determined (corning 400). One milliliter of extract was taken and diluted in 50 ml conical flask with distilled water. The stander solution of the Kcl and Nacl, were prepared by dissolving 2.54 and 3.33g of Kcl and Nacl respectively. Ten ml distilled water to give a 10 ppm concentration. The flame photometer was adjusted to zero using distiller water as a blank and to 100 using standard solution.

Calculation : $K = \frac{F.R \times D.F \times 100}{10 \times s \times 10}$

were :

F.R = flame photometer.

D.F = dilution factor

S = sample weight

3:2:2 Phosphorous contents:

The determination of phosphorus content was carried according to the methods of the Association of official Analytical Chemists (*AOAC*, 2005).

Two mill liters of the extract were pipette into a 50 ml volume flask.

Ten (22.5g of WH4) Mo7 O24 in 400 ml distilled water + 1.25g ammonium van date in 300 ml boiling water +250 ml cone . HNO3. Then diluted to litter where added. The content of the flask were mixed and diluted to volume. The density of the color was read A standard curve of different KH2 PO4 concentration was to calculate the iron and phosphorous concentration.

3:3 Physicochemical methods

3:3:1Total soluble solids

The total soluble solids as percent (T.S.S %) in the different samples were measured as described by *Ranganna* ,2001).

Principle: The index of refraction of a substance is a ratio of light velocity under vacuum to its velocity in the substance which is largely dependent on the composition, concentration and temperature of the sample solution.

Procedure: After the adjustment of the Hand-Refractometer (No.002603, BS-eclipse, UK) with distilled water, the sample was placed on the surface of the Refractometer prism, the prism was closed and the reading was recorded .

3:3:2 Hydrogen ions concentration:

The hydrogen ions concentration (pH) of the different samples was determined as described by Ranganna , (2001).

Principle: The pH value of the different samples was measured with PH meter .After standardization of the pH meter electrodes with buffer solution ,the reading of the sample is recorded as pH value.

Procedure:

After standardization of the pH meter (No,478530,HannaIndia) with buffer solutions (Ph 4.01 and 7.01),the electrode of the pH meter was rinsed with distilled water ,immersed in the sample and left to stand until a stable reading was achieved.

CHAPTER FOUR

RESULTS AND DISCUSSION

4:1 Proximate composition of dried potato slices

Refer to result in table fiber and fat of dried Potato slice (Table 4) were similar to that reported by(*Mosilly* , 2000). He found that the moisture,

protein, fat, carbohydrates, crude fiber and ash contents of potato were 77%, 2%, 0.1%, 19%, 0.4% and 0.9% respectively.

Table (4): Proximate composition of dried potato slices

Composition	**Dried potato slices**
Moisture	**4.28**
Protein	**2.28**
Fiber	**1.07**
Fat	**0.2**
Ash	**4.18**
Carbohydrate	**88**

4:2 Mineral contents (mg/100g) of dried potatoes sliced

Dried potato slice contained almost similar amount of Ca and Mg. The level of K was the highest followed by P, Ca, Mg and then Fe in descending order (Table 5).

Table (5) mineral contents (mg/100g) of dried potatoes sliced

Mineral	Potato thin porridge
Fe	0.4880
Ca	0.99
Mg	2.1414
K	118.78
P	3.59

4:3 viable count of Bifido Bacterium longum log (CFU/ML) of different potato based fermented beverage.

There is increase in Total viable in the maximum Bifido grow in 18 hours. The rates of Bifido bacterium increase were (3.06, 2.2 , 1.84 log)CFU/ml in mix , potato thin porridge and fresh milk respectively. The

viable count of Bifido bacterium obtained in different fermented beverages full filed the number required for Probiotic purposes which is was at least 6 log CFU/ml. (Table 6)

Total (6) : viable count of Bifido Bacterium longum log (CFU/ML) of different potato based fermented beverage.

Time(h)	Potato thin porridge	50%Potato thin porridge and 50% fresh milk	Fresh milk
0 o	3.8 ± 0.0275^{D}	5.7 ± 0.0588^{E}	4.87 ± 0.00891^{C}
6	3.8 ± 0.0235^{D}	5.9 ± 0.01602^{D}	4.8 ± 0.550^{C}
12	4.6 ± 0.0217^{C}	6.5 ± 0.0514^{C}	5.68 ± 0.00905^{B}
18	5.6 ± 0.0246^{A}	8.8 ± 0.0325^{A}	6.7 ± 0.01552^{A}
24	5.5 ± 0.0272^{B}	7.9 ± 0.01510^{B}	6.6 ± 0.0291^{A}

Values are mean± SD for triplicate independents runs.

Values that bear same subscript latter in the same column are significantly Different at $p<0.05$.

4:4 pH reduction of different potato based beverage fermented with *Bifidobacterium longum* BB536

There is decreased in pH by extend fermentation in all types of fermented beverage. The maximum pH reduction was in mix at maximum growth of *Bifidobacterium* ,followed by(Table 7)

Table (7): pH reduction of different potato based beverage fermented with Bifido bacterium longumBB536

Time(h)	Potato thin porridge	50%Potato thin porridge and50%fresh milk	Fresh milk
0	5.68 ± 0.0252^{A}	5.3 ± 0.0577^{A}	6.4 ± 0.0500^{A}
6	5.5 ± 0.0252^{B}	5.2 ± 0.0500^{B}	6.2 ± 0.0500^{B}
12	5.4 ± 0.01000^{C}	4.9 ± 0.0500^{C}	5.9 ± 0.0500^{C}
18	5.3 ± 0.0361^{D}	4.7± 0.0500^{C}	4.9 ± 0.0764^{E}
24	5.2 ± 0.500^{E}	4.9 ± 0.500^{D}	5.1 ± 0.0764^{D}

Value are mean ± SD for triplicate independent run.

Values that bear same subscript latter in the same column are significantly Different at $p < 0.05$.

4:5 TSS % during different potato based fermented beverage Bifido bacterium longumBB536

There is decrease in TSS by extend of fermentation were 0.7, 1.3 , and 0.4% in fresh milk , mix and potato porridge respectively (Table 8).

Table (8) TSS % during different potato based fermented beverage with Bifido bacterium longumBB536

Time(h)	Potato thin porridge	50%Potato thin porridge and50%fresh milk	Fresh milk
0	2.2 ± 0.0500^{A}	2.9 ± 0.1000^{A}	2.8 ± 0.0500^{A}
6	2.0 ± 0.0577^{A}	2.4 ± 0.0513^{B}	2.5 ± 0.0500^{B}
12	1.8 ± 0.0361^{B}	2.0 ±0.1000^{C}	2.4 ± 0.0500^{C}
18	1.8 ± 0.0361$^{B\ C}$	1. 6± 0.0252^{D}	2.1 ± 0.0404^{D}
24	1.9 ± 0.0346^{C}	1.7 ± 0.0252^{D}	2.2 ± 0.0289^{D}

Values are mean± SD for triplicate independents runs.

Values that bear same subscript latter in the same column are significantly Different at $p<0.05$.

4:6 Moisture % of different potato based fermented beverage with Bifido Bacterium longum BB536

The moisture increase in potato porridge and mix at 0 time, which moisture content decrease in fresh milk at 0 time and increase in it with extend time for fermentation.(Table 9) .

Table (9): Moisture % of different potato based fermented beverage with *Bifido Bacterium longum* BB536

Time(h)	Potato thin porridge	50%Potato thin porridge and50%fresh milk	Fresh milk
0	97.5 ± 0.0186^{A}	97.3 ± 0.0465^{A}	94.6 ± 0.240^{D}
6	97.4 ± 0.0623^{A}	96.9 ± 0.0594^{A}	95.5 ± 0.0863^{C}
12	96.8 ± 0.0201^{B}	96.5 ± 554704^{A}	95.8 ± 0.0311^{B}
18	96.1 ± 0.0665^{C}	96.4 ± 0.0161^{A}	96.8 ± 0.0590^{A}
24	96.8 ± 0.1007^{B}	96.2 ± 0.0172^{A}	94.3 ± 0.0584^{D}

Values are mean± SD for triplicate independents runs.

Values that bear same subscript latter in the same column are significantly Different at $p<0.05$

CHAPTER FIVE

CONCLUSION AND RECOMODATION

Conclusion :

During fermentation the maximum increase of *Bifidobacterium longum* BB536 was attained at 18 h fermentation. The growth was accompanied by changes in physicochemical properties. TSS was increase and the moisture and pH were decrease by fermentation . The viable number of

the strain at 18 h fermentation in all types of fermented beverages fulfills the number required to presence in Probiotic product which was at least 6 log CFU/ml. Therefore, fermented potato thin porridge is suitable carrier for *Bifidobacterium longum* BB536 as compared to fresh cow milk.

Recommendations

- Encourage formulation of potato into thin porridge.
- Develop Probiotic fermented beverages using different commercially approved Probiotic strains .
- Further studies are needed on *Bifidobacterium* fermented potato thin porridge to study its shelf life and related nutritional and health benefits
- Carry out further study to determine the nutritional quality of the fermented potato thin porridge.

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