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RESEARCH ARTICLE

NUTRITIONAL QUALITY AND RECOVERY TEST BASED ON A WEANING FLOUR ENRICHED WITH CUCURBITA PEPO SEED IN NIGER

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ABSTRACT

Like other countries, in Niger porridge is the first complementary food for young children. At home, to make porridges, the use of flour or mixture of cereal-based flour of nutritional value remains to be desired. To make our contribution to the improvement of the quality of these flours, a flour enriched with seeds of cucurbits was produced. This flour is composed of a cereal (millet), leguminous (cowpea) and seeds of Cucurbitapepo and manufactured in an industrial environment to ensure the respect of the norms in the matter. After the tests at the factory and the analyzes in the laboratory, a recovery test is carried out on 3 malnourished children in an outpatient nutritional recovery center for the moderates. The mill-selected flour formula is made of 60% millet, 15% cowpea, 15% Cucurbitapepo seeds and 10% sugar. The calculated energy value is 438.58 Kcal and microbiological inferior to the standards. The weights of all children increased after 6 weeks, with a wei gain of between 1 and 3 kg. This can be used in nutritional recovery centers.

INTRODUCTION

Malnutrition is a major public health problem in most developing countries. Niger, a Sahelian country, is not spared by this scourge. It is among the most affected countries in the subregion with a high acute malnutrition rate of more than 16% among children under five. This malnutrition is the cause of a particularly high infant mortality (31.9%) [UNICEF, 1990]. Thus this precarious situation of the children is due mainly to problems of food availability both qualitatively and quantitatively in the country. Indeed it is an agricultural country at 80% and this agriculture is dependent on the vagaries of the single rainy season poorly distributed in time and space. In addition, the diet is mainly carbohydrate, based on cereals, especially in rural areas. Their nutritional intake as other nutrients such as lipids and proteines remains low [Treche 1991]. The various forms of malnutrition begin to manifest themselves generally as early as six months of age, when the need for energy and essential nutrients increases due to the growth of the infant and the inadequacy of the mother's milk to meet his needs. [WHO, 1987].

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It is therefore at this time that complementary foods become important. Thus, the lack of proper weaning food will contribute a lot to the occurrence of malnutrition. There is not one single factor that would be globally responsible for chronic under-nutrition. Several causes are implicated in the occurrence of the latter in Niger (UNICEF, 1990). These include among others, rapid increase in population, the weak knowledge of mothers in nutrition and food related practical young child, lack of food of appropriate weaning. This malnutrition is established shortly after the introduction of semi-liquid or solid products into the child's diet. Although their use after the age of six months is necessary to supplement the intake of breast milk, these products, usually consisting of porridge or food extracted from family meals, appear to be directly or indirectly related to the observed malnutrition (WHO, 1987). In most countries, mothers use porridge as the first complementary food. Only a small minority of them have the financial means to buy industrially-produced flours, most of them imported, which normally make it possible to prepare porridges of good nutritional value. In many cases, however, mothers use flours or blends of local flours that have not undergone any specific treatment and are generally of very low nutritional value (Treche, 1991).

Given the increase in cases of malnutrition, the MSP / LCE with the collaboration of development partners (UNICEF, WHO, HKI) developed in August 2005 a national protocol for the management of malnourished cases. This national protocol standardizes the criteria for admission, discharge, dietary and medical care plan as well as data collection tools. It also specifies the overall strategy in which care is taken into account and takes into account the adaptations to be implemented during periods of crisis (MSP, 2005).

It is thus necessary to build capacity in the reflection of new formula given the great potentiality of diversity of usable ingredients, and this will in no way help to reduce malnutrition and poverty, as artisanal production could contribute to improving the economic status of populations [PNSN, 2017]. It is in this perspective that we i ntéressés with pumpkin seeds *(Curubitapepo,* Linn). Indeed it is a widely distributed species, the culture of which requires little care and nutritional profile has been established. Also, it is with a view to making our modest contribution to the improvement of complementary foods for young children that we have proposed this work on the production and analysis ofthe nutritional value of a millet-based infant flour, cowpea-enriched cowpea, followed by a test in a nutritional recovery center.

MATERIALS AND METHODS

Framework of the study: The flour is produced at the Food Company s transformation (Niamey), the Protection of Mother and Child Center (PMI) KoiraTegui (Niamey) for the flour test in a real environment. The Center for Recovery and Nutritional Education in Moderate Ambulatory Tanout in the region of Zinder (about 1000 km east of the capital Niamey).

Flour production: To produce a good quality flour, in large quantity and in acceptable hygienic conditions we asked for and obtained the agreement of the food processing company (STA). It is the only company that is interested in the production of food s withdrawal.

Plant material: The plant material used is composed of: Mil (*pennisetumamericanum* L.), bought on the market of Niamey; Cowpea *(vignaunguigulata*), kalfou (Tah or a) and squash seeds (*cucurbitapepo*), bought on the Niamey market.

Method of preparation of plant material: The raw materials (millet, cowpea and squash seeds) have undergone several stages of STA preparation, namely: winnowing or cleaning, dehulling, washing, drying and roasting. After the roasting of the various ingredients separately, the weighing of each ingredient was done in relation to the proportion retained as well as that of the sugar. Then the whole was mixed and milled in a mill to get the flour After milling, the flour is sifted and bagged in 500g packages (Voir diagramme ci-dessous)

Method of flour production: Six flours were produced according to the proportions of the ingredients specified in the table below:

Tasting test : The objective of quality control on a production line is to react, within a very short time, on the manufacturing parameters in order to control the production. For this purpose before the tasting test itself we conducted a pre-test on site with the agents of the Food Processing Company. The 16 agents appreciated the six flour s and chose three flours.

This assessment was made according to the criteria of taste, color, smell and classify 1st, 2nd, 3rd.

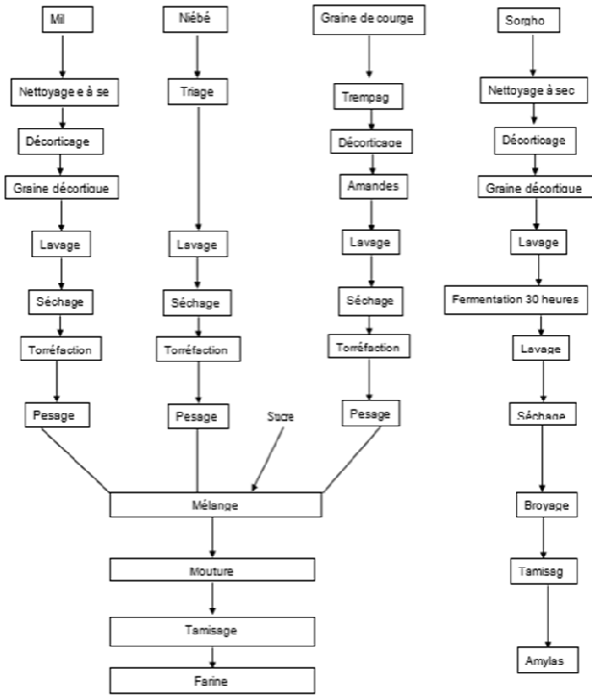

Diagramme technologique de fabrication de la farine et de l'amylase

After the near-test, a sensory analysis was carried out on the three flours retained and the porridges prepared from these flours to appreciate the organoleptic characters: color, taste, texture, and smell. This and a panel was made up of thirty women with a child of childbearing age who came to the infant consultation at PMI Koira. tegui. The assessment was made according to the ranking criteria in order of preference of the best at least good on all the organoleptic characteristics for flour and porridge prepared with these flours.

Stechnicalanalysis of raw materials and the chosen meal: The moisture content was determined on the flour by drying in an oven (mark marmmerl) at 103 ° C overnight (about 12 hours) according to the AOAC method (1984). The fat was determined according to the Soxhlet method with hexane. Total proteins are determined according to the kjeldahl method, reported by Wolf (1968). Ashes are obtained after dry mineralization of the flour at 550 ° C for six hours in the oven (hereausmark) according to the AOAC method (1984). The carbohydrate content is determined by calculation.

Carbohydrate content = 100 - [lipid content + protein content + ash content + water content]

Energy value of flour: The calorific value of the flour is determined by calculation.

Nutritional value = 4 times carbohydrate content + 4 times protein content + 9 times lipid content

Microbiological characteristics (CNERNA, 1996) These were the following determinations made on the retained meal: Escherichia coli at 44 ° C, salmonella at 37 ° C, yeasts at 30 ° C, mold at 30 ° C, total coli forms 30 ° C and mesophilic aerobic Flora 30 ° C.

Table 1. The proportions of ingredients of manufactured flours

	ingredients			
Number of flour	mil	cowpea	Squash seed	sugar
1	60%	10%	20%	10%
2	60%	20%	10%	10%
3	60%	20%	15%	5%
4	60%	25%	10%	5%
5	60%	15%	15%	10%
6	60%	15%	20%	5%

Table 2. Distribution of the pre-test according to the assessments in order of preference

	ranking		
Number of flour	first	2nd	3rd
1	13	3	0
2	2	10	4
3	0	1	2
4	1	1	13
5	0	0	0
6	0	1	0

Table 3. Formula of three flours retained in the pre-test by ordre preferably

	Ingredient in%			
Formula	mil	cowpeas	seed	sugar
1	60	15	15	10
2	60	10	20	10
3	60	20	15	5

Table 4. Distribution of the panel of appreciation according to the organoleptic characteristics of flours

NOT of flour	Taste	Color	odour	Preference
1	21	15	17	20
2	2	6	2	0
3	7	9	11	10

Table 5. Distribution of the tasting panel according to the characteristics of the slurries prepared with the three flours

NOT of flour	Taste	Color	odour	Preference
1	23	18	22	21
2	3	5	7	7
3	4	7	2	2

Table 6. Chemical composition of flouringredients

ingredients	Mil (%)	Iébé N (%)	Squash Seed of squash (%)
Carbohydrate	77.14	68.02	14 , 18
proteins	13.18	23.22	32.5
Lipid	6.6	4.13	47.5
Water content	1.22	1, O1	2.36
ashs	1.86	3.62	4.46

Table 7. Chemical composition of the flour used.

protein s	lipid	Carbohydrate	humidity	ashs	phosphorus
18.11%	10.78%	67.23%	1.97%	1.91%	0,26mg / kg

Table 8. Features biological micro flour in number of seed per gram of thefarin

Microorganism	Quantity in 1g
Escherichia Coli at 44 ° C	0
salmonella at 37 ° C	0
Yeastsat 30 ° C	0
Mold at 30 ° C	20
Total coliforms at 30 ° C	53
Mesophilicaerobicflora 30 ° C	300

Recovery test

Type of study: This is an experimental study to determine the effectiveness of flour in the nutritional recovery of malnourished children.

Study population: The population of our study is composed of all the moderate malnourished mother-child couples who came to consult infants at the CSI urban Tanout.

Sampling method: We used the convenience sampling method.

Study sample: Our study sample is composed of the three malnourished children received during the day of March 15, 2006 at TANOUT urban CSI.

Techniques and tools for data collection: The technique used is the measurement of weight, height of the children who came for consultation in order to detect the malnourished with the aid of the anthropometric table. After the screening we conducted an individual interview with mothers of malnourished children to determine the age, health status and diet of these children.

RESULTS AND COMMENTS

The characteristics of flours

Frequency distribution of the pretest performed at the STA.

Table II: distribution of the pre-test according to the assessments in The analysis of this table shows that Of the 16 agents, 13 found flour number 3 very good, 10 found flour number 2 good and 13 found flour number 4 passable. Thus the three flours selected in order of preference are:

- First 3
- Second 2
- Third 4

All three meals are obtained according to the following formulas collected in the following table. According to this table all the flours retained consist of 60% millet, 10% sugar for flours 1 and 2. This shows more acceptability in flours that contain 10% sugar and a high seed rate (15%, 20%). On the other hand, flour 3 which has 5% of sugar, 20% of cowpeas and 15% of seeds are less accepted by agents. This meets the standards that a flour should not exceed 60% of cereals and 10% of sugar. (Claire, 1998)

Distribution of the panel of appreciation of the organoleptic characters of the three flours retained by the mothers in KoiraTegui: The three flours from the pre-test performed at the STA were transferred to the real world and more specifically to Koira. tegui . There the mothers of children accustomed to infant flours and porridge were implemented. After they were asked to classify these flours in order of preference. The results obtained are grouped in the following table. Analysis of the results of the re table shows that: The number 1 has flour is best appreciated on all the organoleptic:

Table 9. Composition of the sample according to: Indices, anthropomeric indicators and their state of health

children	Age (in months)	Weight (kg)	Size (cm)	P / T	Health	Degree of malnutrition
1	21	7.8	80.2	<75%	Good	moderate
2	17	6.7	75.3	<70%	Good	Strict
3	16	6.6	74.4	<70%	Bad	strict

Table 10. Evolution of weight in children tested

NOT child	Initial weight	Weight after 2 weeks	Weight after 4 weeks	Weight after 6 weeks
1	7.8	8.3	8.8	9.4
2	6.7	7.3	7.2	7.8
3	6.6	6.8	7.2	7.4

Table 11. Comparison of microbiological quality of flour produced and enriched with the seeds of *Cucurbitapepo* and those of GRET / ORSTOM and MISOLA.

	Flour enriched with pumpkin seeds	Microbiology standards proposed by Gretand Orstom	Quality bacteriological flour MISOLA
Escherichia Coli	0	<10	< 10 / g
Salmonella at 37 ° C	0		<1 / 25g
Yeast and mold <1000	20	<1000	< 1000 / g
Total coli forms at 30 ° C	53	<100	< 1000 / g
Mesophilicaerobicflora 30 ° C	300	<100	< 200000 / g

Distribution of the tasting panel according to the organoleptic characteristics of the three porridges by mothers in Koira Tegui

The analysis of this table shows that a flour # 1 consisted of 60% millet, cowpea 15%, 15% seed and 10% of sugar is the most accepted on all organoleptic criteria.

Chemical composition of the ingredients of the retained flour

The millet, cowpea and squash seeds used in the manufacture of our flour are analyzed and the results are as follows. According to the analysis in this table, millet and cowpea are very rich in carbohydrate with respectively 77.14% and 68.02%. As for squash seeds they do not contain only 14.18%. For lipids the values are 6.6%; 4.13% and 47.5% respectively for millet, cowpea and pumpkin seeds. Protein levels are: 13.18% for millet, 23.22% for cowpea and 32.5% for pumpkin seeds. For ash and water contents, the values are respectively 1.86% and 1.22% for millet; 3.62% and 1.01% for cowpea 4.46% and 2.36% for pumpkin seeds.

Chemical composition of the retained flour: The flour obtained was analyzed from a chemical point of view and the results obtained are collated in the table. The table gives us information on the chemical composition of the flour used. This shows a well-dried flour with 1.97% moisture, rich in protein with just under 20%.

Microbiological characteristics of the flour retained: The retained flour was microbiologically tested and the results are summarized in the following table. The analysis of this table shows that Escherichia coli, salmonella and yeasts at the following respective temperatures, 44 ° C, 37 ° C, 30 ° C are non-existent. Total coliforms, mold and aerobic flora mesophilic at 30 ° C are respectively 53 and 300 per gram of flour.

Therapeutic test: Composition of the sample according to indices and anthropometric indicators and their state of health Our sample consists of three malnourished children who frequent the center of Tanout.

Their age, weight, height, weight in relation to their height and state of health are reported in the following table. The age of children is between 17 and 21 months, the weight between 6.6 and 7.8 Kg and a size of 74.4 and 80.2 cm. Regarding the degree of malnutrition determined by the weight-to-height ratio and the state of health they are respectively moderate (<75%) and good health for the first, severe (<70%) and a good health status for the child. second, severe (<70%) and poor health for the third.

Results of weight gain in treated children: The three children in our sample are seen every two weeks to see the evolution of their weight and state of health after eating the porridge. The weight of the children after two weeks each s is reported in the table below. This table shows an increase in the weight of the three children fed on porridge-enriched cereal porridge.

So after 6 weeks the weight of these children is as

Child 1: From 7,8 to 9,4kg, Child 2 : from 6.7 to 7, 8kg, Child 3: from 6.6 to 7, 4kg

Chose and processing of the raw material: In the design and realization of this flour the choice and treatment of our materials has met the criteria of nutritional and cultural value, availability, accessibility, cost, and educational aspect. These criteria of choice of raw materials are the same ones that used " bitamine " Niger. The choice of heat treatment after cleaning and drying aims to reduce humidity, destroy bacteria and insects, the treatment allows the development a taste particularly appreciated, also allows to cook the product. The roasting of the ingredients facilitates digestibility and gives the porridge a good taste appreciated even by malnourished children with anorexia.

Proportion and chemical composition of ingredients: Thus the product is suitable for use as a staple in demonstrations under the National Nutrition Education Program. The proportions of the ingredients of our flour can be compared to that of the composition of misola flour (Burkina Faso) where the proportions of the following ingredients are used. Grilled 60% small millet or 3 volumes, Grilled soy 20% or 1 volume,

Peanut grilled 10% or ½ volume; Sugar 9% or 1/4 volume and iodine salt 1%. (Severine, 2004).

Chemical composition of flour: The characteristic physicochemical flour produced can be compared are those of the Misola flour although the ingredients are not the same. For 100g of flour we have protein ≥ 15g lipids ≥ 11g carbohydrates 61g ± 2g, Energy value ≥ 425 Kcal or ≥ 1775 joules , Humidity ≤ 5g and mineral matter ≤ 3g. It can be seen that the energy value of flour enriched with pumpkin seeds exceeds that of Misolaflour. From a microbiological point of view, infantile flour must be safe, must not contain pathogens, toxins or toxic chemical residues that affect ealth infant, particularly should pa s cause diarrhea. The flour produced is compared to the microbiological standards proposed by Gret and Orstom. We find that for all micro-organisms selected micro biological results are below our flour to those proposed by GRET and ORSTOM. (Memina,1994). This flour does not contain salmonella neither aflatoxins which asserts its microbiological quality.

Porridge/ Method of preparing porridge: The child who is well-nourished or malnourished requires foods with a high energy density, at least equal to that of breast milk. So to have the required qualities the porridge must be prepared according to the recipe : a volume of flour for two volumes of water. Respecting these proportions makes it possible to prepare a slurry of high energy density and composition adapted to the growth of the child or the treatment of malnutrition. The young child does not have the capacity to ingest thick porridges, the malnourished child is often anorexic and badly digests starch. The consistency of the mixture must be adapted to the child by adding amylase e which allows to fluidify it.

Thecontribution of flour in nutritional recovery: Indeed, the nutritional recovery test with millet flour enriched with legume and pumpkin seeds, CRENAM Tanout, allowed us to see the effectiveness of this flour, because the weight of all children supported systematically increased after 6 weeks and no mother reported a diarrhea problem. Which leads us to say that this flour can be used in the context of nutritional recovery at the level of CRENAM.

Conclusion

After this study, which aimed at the production and analysis of infant meal using local products (millet, cowpea and pumpkin seed s), we can draw the following conclusions. Cooking is a simple technique recommended. This method makes it possible to have a flour of taste and aroma much more pleasant. Due to the availability of ingredients (s products from agriculture) flour and its simple production method, this flour is available to all.

The elaborate meal is well balanced energy as nutrient s and instant flour preparation comparable to known commercially as flour "bitamine" in Niger. In addition, flour made from cereals enriched with x pumpkin seeds by its composition and its high energy content can be used as complementary food for infants and young children. However this flour obtained conformity, the x s standard of quality of a good meal has been satisfactory therapeutic test CRENAM Tanout. T hus the flour can be used in the nutritional rehabilitation sessions, but before further analysis should be conducted on é digestibility in vivo, in vitro and has amino acid composition.

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