

Bambara Groundnut Committee Paper for Discussion

Committee Paper for Discussion - ACNFP/152/04

Advisory Committee For Novel Foods and Processes

**Traditional Food Notification Number RP1086 - Bambara
groundnut**

Issue

1. A notification for Bambara Groundnut (*Vigna subterranea*), a traditional food from a third country, has been received under Regulation (2015/2283) (EU retained law).
2. The Committee is asked whether there are safety concerns with the proposed use of this traditional food in the UK market. The information from the Committee will provide the basis for risk management decisions made by the UK.

Background

3. On the 10th of May 2021, the FSA received a notification from Bio-Innovation Zimbabwe for authorisation of Bambara groundnut. The applicant intends to market the product in dried, roasted, and canned forms as well as ground into a flour.
4. The FSA and FSS has four months to provide reasoned safety objections to the Traditional Foods sale in the UK. If authorised, the authorisation will be open to any company subject to the specification and conditions of use detailed in the dossier. A risk assessment on the safety of this traditional food is requested to inform this process.

5. The notification dossier is attached as **Annex A**. Relevant supporting information is attached as **Annex B and C**. These annexes contain confidential information.

Identification

6. Geographical origin of this groundnut is widespread across African countries, South-east Asia, and Brazil. The applicant states that the groundnut under this application will be sourced from various regions across Africa. Bambara groundnut also referred to a bean, is a tropical legume crop that grows underground and has many names depending on region of prevalence (Bambara is a region in Africa).

7. The applicant also states that the forms under which the food is marketed are all used traditionally both hulled and un-hulled. Depending on the region farmed, the hulled dried seeds come in different colours and sizes. They are roundish, are especially of cream/brown/grey/black colours with a white helium. Genetically, Bambara groundnuts are very similar to mung beans with whom they share the same genus *Vigna*.

Production Process

8. Historically in Africa, the crop is usually grown for home consumption with the excess sold in local markets although with an increase for demand in Europe, industrialization of farming is increasing. The production methods described in this application are all traditional (manual) but the applicant states that if approved the methods will be adjusted to allow for industrial standardized processing with further sophisticated machine set-up.

9. Planting and harvesting varies across regions in Africa and are mainly done manually. Pods are sun-dried for up to a month then shelling is done either mechanically or manually using jutes and sticks. Winnowing is also done manually, and the groundnuts put into storage drums/bags/granaries. The safety concerns and their mitigation in the steps between planting to transfer to the processing facilities has been further clarified in a response to further information in Annex C.

10. The applicant states the dried groundnut is imported into a HACCP certified production facility with inspection carried out on all batches. HACCP and steps for inspection and mechanical cleaning is outlined. Those intended for sale in the

dried form are packaged and stored at -18°C to control insects (weevils) or vac-packed. For all other processed products i.e., canned, roasted and flour, the groundnuts are dehulled. Dehulling process included in a detailed flow chart as well as roasting, canning, and milling (Annex A pages 21-29).

Composition

11. The applicant has given an extensive analysis of Bambara groundnut through literature review (Annex A pages 29-46). The composition of the nutrients has been listed and evaluated in detail in relation to the different forms of the marketed product. Comparisons are made to other staple legumes (Table 1) to address any question of nutritional disadvantage.

Table 1 - Overall nutrient values of Bambara beans compared to other legumes (Le Breton, 2015)

Nutritional Component	Bambara nut	'Common bean' e.g., kidney	Cow pea	Butter bean	Groundnut (peanut)
Energy (kcal)	366	388	343	338	567
Protein (g)	24	22	23	21.5	25.8
Fat (g)	6.2	0.7	2.1	0.7	49.93
Carbohydrate (g)	60.9	63.4	59.6	63.4	16.13
Dietary fibre (g)	5.3	19.0	10.7	19.0	8.5
Calcium (mg)	256	81	85	81	92

Iron (mg)	18.0	8.2	9.9	7.5	4.6
Magnesium (mg)	347	224	333	224	168
Phosphorus (mg)	738	385	438	385	376
Potassium (mg)	1702	1724	1375	1724	705
Sodium (mg)	13	18	58	18	18
Zinc (mg)	6.78	2.83	6.1	2.83	3.27
Vitamin A (mg)	9.0	0	0.033	0	0
Vitamin C (mg)	0.67	0	1.5	0	0
Thiamine (mg)	0.29	0.51	0.7	0.51	0.64
Riboflavin (mg)	0.11	0.2	0.2	0.20	0.13
Niacin (mg)	2.03	1.54	2.8	1.54	12.01

12. The applicant finds that amino acid content of Bambara groundnut is very similar to that of mung and black beans and that the essential amino acid content of all 3 pulses meets recommended daily intake levels with exception of methionine, threonine, and tryptophan (Table 2). They also find that germinating, fermenting, and roasting processes changes the profile of amino acids with most notable changes of lysine and aspartate being lowered and arginine raised (Table 3).

Table 2: Amino acid composition of Bambara nut protein isolates compared to other legumes (Kudre et al., 2013)

Amino acid % relative to total amino acids		Content in protein isolate mg/g		
Bambara nut		Mung bean	Black bean	Recommended intake*
Histidine	29.9	27.9	29.0	19
Isoleucine	37.6	39.1	39.8	28
Leucine	73.2	74.0	74.1	66
Lysine	63.0	62.4	60.3	58
Threonine	27.6	28.4	25.0	34
Tryptophan	7.3	6.4	7.6	11
Valine	43.2	46.3	45.5	35
Methionine	12.7	12.5	12.9	25
Phenylalanine	63.3	58.0	56.7	63
Alanine	35.1	36.6	35.5	-
Arginine	59.0	64.4	64.3	-

Aspartic acid/ asparagine	95.6	85.3	95.8	-
Glycine	30.9	32.2	32.5	-
Glutamic acid/ glutamine	154.1	125.4	141.5	-
Proline	26.8	30.0	28.4	-
Tyrosine	32.8	32.3	33.5	-
Serine	32.7	38.5	35.7	-
Total amino acids (AAs)	810.7	800.2	816.4	
Total essential AA's	338.9	348.2	344.6	
Total aromatic AAs	93.4	96.7	97.8	
Total sulphur AAs	12.7	13	12.9	

* Recommended daily intake (FOA/WHO,1991) in mg/kg bw / d

Table 3: Amino acid content of germinated, fermented, and roasted Bambara groundnut (from Ijarotimi et al 2019)

Amino acid	Raw nut	Germinated	Fermented	Roasted
Lysine	3.02	5.20	4.80	5.01
Histidine	2.27	2.60	2.10	2.40

Arginine	8.81	6.03	5.16	4.85
Aspartate	4.89	9.36	10.12	9.61
Threonine	2.58	2.63	2.05	2.55
Serine	ND	3.34	3.02	1.96
Glutamate	15.83	13.35	13.57	14.51
Proline	ND	3.11	2.20	2.31
Glycine	3.60	3.92	4.03	2.99
Alanine	3.38	2.04	1.80	2.30
Cystine	0.61	1.10	1.04	0.84
Valine	ND	4.01	3.25	2.60
Methionine	1.78	1.04	1.24	1.14
Isoleucine	3.81	3.54	4.05	3.80
Leucine	6.73	7.13	6.30	7.44
Tyrosine	3.11	3.20	3.00	2.80
Phenylalanine	4.43	3.18	4.30	3.78

13. Mineral content is comparable to soybean and groundnut, although potassium is higher in Bambara. Levels of calcium, phosphorus, sodium and potassium in lima bean and pigeon pea were lower than in Bambara (Table 4). The content of calcium potassium, sodium and iron were similar, whereas magnesium and zinc were higher, and phosphorus lower, in the dehulled seed (Table 5). all processes affected the mineral content to some extent, mainly as a loss. The effects of boiling confirm the loss of calcium, magnesium, and zinc. Table 6).

Table 4: Comparison of minerals in selected other legumes (Fasoyiro, Ajibade, Omole, Adeniyi, & Farinde, 2006)

Legume	Sodium	Potassium	Calcium	Phosphorus	Iron
Bambara nut	0.05	0.37	0.40	0.46	0.003
Lima bean	0.04	0.30	0.20	0.34	0.004
Pigeon pea	0.02	0.18	0.26	0.34	0.003
Soybean	0.04	0.16	0.40	0.56	0.008
Groundnut	0.07	0.20	0.41	0.41	0.002

Table 5: Mineral content of whole and dehulled seed (Olaleye, Adeyeye, & Adesina, 2013)

Mineral (mg/100g)	Dehulled seed	Whole seed
Calcium	82.2	77.7
Magnesium	31.9	20.9

Potassium	49.3	50.7
Phosphorus	10.0	39.6
Sodium	24.9	23.9
Iron	5.27	4.2
Zinc	40.2	25.6

Table 6: Effect of boiling, soaking, roasting and autoclaving Bambara nuts on mineral content (Adegunwa, Adebowale, Bakare, & Kalejaiye, 2014)

Treatment	Calcium	Magnesium	Sodium	Iron	Zinc
Autoclaved	725.0	122.5	13.33	2.94	0.51
Boiled	680.0	114.5	12.68	1.62	0.58
Lukewarm water	745.0	110.00	15.52	2.54	0.77
Hot water	620.0	103.0	15.16	1.76	0.63
Roasted	560.0	126.50	13.08	2.42	1.39
Raw	765.0	133.5	9.27	1.89	1.06

14. The Bambara groundnut contains about 6% fat which consists of linoleic, palmitic and linolenic acids as most dominant fatty acids. Stearic acid is present in small quantities. For whole seeds, the most concentrated saturated fatty acid is palmitic acid, most concentrated un-saturated fatty acid trans-II vaccenic acid while the most concentrated polyunsaturated fatty acid is rumenic acid (conjugated linoleic acid).

Table 7: Fatty acid composition of testa (cotyledon removed), dehulled and whole seeds of Bambara groundnut (Adeyeye et al., 2015)

Fatty Acid	Testa	Dehulled	Whole seed	Mean	SD	CV%
Dodecanoic acid	-	-	-	-	-	-
Myristic acid	0.0003	0.0001	0.0004	3E-04	7E-05	26
Palmitic	13.6	11.7	11.8	12.37	0.92	7.44
Stearic acid	3.99	2.22	2.31	2.84	0.859	30.2
Archidic	0.76	4.45	4.84	3.35	2.065	61.6
Behenic acid	0.32	0.22	0.24	0.26	0.042	16
Lignoceric acid	0.05	0.14	0.09	0.093	0.024	25.8
Myristoleic acid	0.58	0.09	0.01	0.227	0.288	127
Palmitoleic acid	0.20	0.08	0.36	0.213	0.089	41.6
Petroselinic acid	6.59	9.75	9.45	8.597	1.468	17.1
Oleic acid	6.69	9.16	7.88	7.91	0.696	8.8

Cis-II Gondoic acid	0.31	0.21	0.21	0.243	0.051	20.9
Erucic acid	0.18	0.12	0.14	0.147	0.021	14.6
Nervonic acid	0.006	0.008	0.01	0.008	0.002	25
Trans-Petroselinic acid	5.67	12.2	8.08	8.65	1.582	18.3
Elaidic acid	9.68	9.93	7.71	9.107	1.013	11.1
Trans-II Vaccenic acid	4.35	8.83	12.1	8.427	3.877	46
Linoleic acid	20.9	13.9	14.4	16.4	3.329	20.3
Gamma-Linolenic acid	0.98	0.006	0.67	0.552	0.221	40
Eicosadienoic acid	0.40	0.28	0.29	0.323	0.056	17.4
Dihomo-gamma-linolenic acid	0.85	0.58	0.62	0.683	0.119	17.4
Arachidonic acid	0.14	0.09	0.14	0.123	0.01	7.8
Docosadienoic acid	0.20	0.14	0.21	0.183	0.013	7.35
Rumenic acid	21.5	15.5	16.1	17.7	2.774	15.7
Alpha-Linolenic acid	1.13	0.005	0.77	0.635	0.256	40.3
Eicosatrienoic acid	0.60	0.41	0.45	0.487	0.078	16.1
Timnodonic acid	0.01	0.01	0.15	0.057	0.071	126

Docosahexanoic acid	0.006	0.005	0.002	0.004	0.002	46.4
---------------------	-------	-------	-------	-------	-------	------

15. A list of anti-nutrients commonly found in Bambara have been examined in detail within all processes proposed. Processing substantially changes levels reducing them in most cases see Annex A pages 43-46.

Table 8: Antinutrient content of whole and dehulled Bambara nut (Olaleye et al., 2013)

Antinutrient	Dehulled seed	Whole seed
Tannic acid (mg/100g)	0.76	0.09
Phytin phosphorus (mg/100g)	4.93	4.06
Phytic acid/ phytate (mg/100g)	17.5	14.4
Oxalate (mg/100g)	8.59	5.02
Saponin* g/100g	1.38	1.10
Alkaloids* g/100g	0.27	0.14

Table 9: Antinutrient content of raw, soaked, boiled, roasted, and autoclaved Bambara nut flour (Adegunwa et al., 2014)

Antinutrient	None (raw)	Roasted	Warm soak	Hot soak	Boiled	Autoclaved
--------------	------------	---------	-----------	----------	--------	------------

Tannin (mg/100g)	0.96	0.71	0.86	0.80	0.55	0.30
Phytate (mg/100g)	15.30	14.68	11.65	12.35	11.28	9.29
Oxalate (mg/100g)	1.22	1.13	0.99	1.17	1.11	1.05

16. The applicant was requested for further information on risks associated with this product on mycotoxins, PCBs/dioxins, heavy metals, and microbes. They responded by submitting test results of a sample batch explaining that due to the product not being manufactured yet, they only did analysis on one batch of the raw ingredient in order to demonstrate that the theoretical specification is feasible, and that more batch testing will be done as production commences. The COAs can be found in Annex B. They were further queried on the presence of some mycotoxins and their impact on the product, a response that can also be found in Annex B.

Stability

17. The applicant states that stability data can be extrapolated from mung beans or chickpeas. However, they do also state that stability testing will be performed, and the protocol outlined (section 2.4.4/5 of Annex A). Applicant proposes a 12month shelf life to be extended after suitable stability testing for dried and roasted, 18 months for canning and 6 months for flour, this is with consideration of some specification data of certain similar products. Parameters have been set out for the different processes most importantly the moisture, mycotoxins, pH, microbial and absence of pests. A request for further information on extrinsic factors such as storage and environment was sent with the applicant yet to answer this. However, they propose real time stability tests of products once manufacture commences.

Specification

18. The application specifies Bambara in 5 forms: dried hulled, dried dehulled, roasted dehulled salted & unsalted, canned in salt water and ground to a flour. They follow generic specifications of comparable legumes used within Europe and especially chickpeas because they are available in all the forms proposed for Bambara. A variety of specification tables presented on the various forms of the product can be found in Annex A pages 50-62.

History of Continued Use/Traditional Use

19. The applicant has given an extensive history of continued use (Annex A pages 63-88). Bambara groundnut is cultivated throughout Sub-Saharan Africa as a staple in a variety of countries (26 listed) as per the accessions to the International Institute of Tropical Agriculture, 2019. In 2020, the UN wrote Bambara is indigenous to Sub-Saharan Africa. Noted, Bambara was exported for cultivation in S. America, Asia, N. Australia (Burkill, 1906).

20. A comprehensive range of publications documenting use of Bambara has been explored and a table tabulated in Annex A page 65-76, dating from 1970-2021 with various processes mentioned such as roasting, boiling and canning.

21. Characteristic of the population groups of consumers includes people of all ages except breast-fed children. The role in the diet is explored with variation on staple, snack and as a speciality suggested where imported in the West and for health due its content of protein and fibre.

22. Information on handling and preparation is explored in detail. Precautions for the preparation and restrictions of use are also briefly explored such as bloating, constipation and flatulence especially after improper cooking which the applicant also attributed to other legumes from publications. Some human data discussed, quite similar to the history of use as well as use as feed specifically the unwanted leaves and stems.

Proposed Conditions of Use

23. The target population is adults, excluding babies and vulnerable groups not able to digest solid food. The applicant states that this product could potentially replace other legumes consumed as an alternative to mung beans and chickpeas which they are similar to.

24. There is no proposed maximum use although the expected use levels are predicted to be similar to mung beans and chickpeas. In the same context, the

applicant has done comparisons of chronic consumption of these similar legumes as a comparator for estimation of Bambara. This is done for each processed type i.e., dried, roasted etc.

25. The applicant states the groundnut will not pose a nutritional disadvantage. A nutritional composition comparison of the legumes it could potentially replace is given (mung, soy, chickpea, cowpea).

26. Applicant acknowledges Bambara contains allergenic proteins with cross-reactivity between peanut and soybean allergens but then goes on to state there are no precautions of use. A request for further information on better evaluation on allergenicity was sent to applicant with their response in Annex C concluding that explicit labelling as to the origin of the product is always required, and a general warning as with peanuts may be appropriate.

Committee Action Required

- Members are asked whether there are safety concerns that need to be managed with this traditional food from third countries.
- The Committee's advice will form the basis for the UK's formal response to the Commission and whether reasoned safety objections are submitted.

Secretariat

March 2022

Annexes (Confidential)

Annex A - Bambara Groundnut Dossier

Annex B - Supporting Documents

Annex C - Request for Further Information