SOME PHYSICAL AND NUTRITIONAL PROPERTIES OF FOURTEEN NEWLY DEVELOPED VARIETIES OF GROUNDNUTS (*Arachis hypogaea*)

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SUMMARY

Some physical and nutritional properties of 14 newly developed varieties of groundnut produced by the Savanna Agricultural Research Institute (S.A.R.I.) were studied. The physical parameters measured were the grain size, colour and 100 kernel-weight. The protein and fat contents are the nutritional content measured. The study indicated variety ICGV-92099, CS-49, ICGV-88761had high fat content (51%, 51.6%, 50%) making them useful for oil extraction.

Those varieties that could be used in diets for their high content of proteins are: JL – 24, CHINESE and ICGV – 92099. Others were ICGV-SM -98029 and MANI PINTAR.

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1.0 INTRODUCTION

The groundnut, also known as the peanut originated from South America but is now indigenous in West Africa, China and India and is cultivated in large quantities in the semi-arid tropics (Ihekoronye and Ngoddy, 1985). Major producing countries in Africa are Nigeria, Senegal and Sudan. In Ghana, cultivation is centered around the Northern and Upper regions and in Brong Ahafo Region, which produces about a fifth of the country's supply. (Abbiw, 1990)

It is important both as an export crop and as a local food crop. (Kordylass, 1991)

As a food crop, groundnut is one of the most important sources of edible oil and is grown mainly for this product. It contains about 47-50 per cent oil in the shelled nut. It is rich in protein, containing about 30 per cent and it also contains some carbohydrates, about 10 per cent. These constituents make groundnuts one of the concentrated food crops high in energy (calories). Groundnut protein is highly digestible and has many uses both for human and animal consumption. It is also an excellent source for the B vitamins and also high in vitamin E. (Ihekoronye and Ngoddy, 1985)

There are many ways of preparing the nuts for direct consumption –by roasting or boiling or for native dishes, by fermentation. For example, Kulikuli, a roasted Nigerian groundnut cake, which is prepared by grinding dehulled groundnuts to a smooth mash, spiced and fried in its own oil after removing the oil from it, has become very popular in Northern Ghana as well.

In spite of its importance in nutrition, the vegetable oil industry in Ghana has not been well developed. This can be attributed to a number of reasons. Key among these is the low level of technologies designed for the production and processing of these cooking oils. This has resulted in meagre profits for oil-producing farmers as well as non-optimal use of groundnuts in Ghana. To address this problem, an agronomic plan on improving groundnut varieties was undertaken at the Savanna Agricultural Research Institute (S.A.R.I.).

in Ghana by increasing the utilisation of groundnuts. It is aimed at characterising and finding the

This work is part of the investigation to deal with the problem of poverty

best variety of groundnuts, which can be used to prepare nutritious foods. The objectives of the study were,

1. To evaluate some of the physical parameters of the groundnut varieties which are relevant to their processing characteristics.
2. To evaluate some chemical and nutritional characteristics of the various groundnut varieties.

2.0 THE GROUNDNUT

Groundnut, *Arachis hypogaea* is an oil –bearing legume cultivated in large quantities in tropical Africa especially in the Sudan and Guinea savanna woodland countries.

Pods are produced from small inconspicuous flowers an inch or two above the ground; after fertilization the flower bends downwards by rapid growth of the pod stalk into the ground, where it grows to maturity. Pods hold up to four seeds, and a single plant fully grown may produce forty or more pods.

One variety of plant is rather upright and produces tufted bunch of seeds, covering a ground area of up to eighteen inches across; the others are lower-growing and rather have more spreading habit.

The mature seeds are elongated, cylindrical or egg-shaped and about 1-2cm by 0.5 cm in size. The different types vary in shape, size and skin colour. The colour varies from white, pink, red and purple to shades of brown.

2.1 NUTRTIONAL COMPOSITION OF GROUNDNUTS

Groundnut contains proteins, fat and some carbohydrates (Parker et. al, 1993). The oil from the nuts is used for cooking and has a mild or bland flavour. The oil shows good resistance to oxidation. Its fatty acids consist of about 20 per cent saturated and 80 per cent unsaturated. Groundnut oil contains up to about 30 per cent linolenic acid, which is an essential fatty acid and plays a major part in human diet.

2.2 USES OF GROUNDNUTS

Groundnuts as a seed legume are of major nutritional importance especially in the developing world. It has low water content when mature and store well. As with most oil-bearing vegetables, almost all of the groundnut plant is useful. The residue from squeezing the oil out of the seeds is a protein-rich cake, a highly nutritious food for

animals and can also be processed into flour and used to prepare biscuits, chocolate and other confectionery goods. (Bergeman et.al.1981)

The vines, or 'haulm', make excellent hay for the same purpose. Recently a process has been developed for extracting some of the protein from the crushed cake and converting it into a synthetic fibre, from which cloth can be made.

Of the nut itself, about 42 per cent is extractable as oil of excellent edible quality, used not only as an ingredient of margarine and cooking fat but also in several hundred food products.

3.0 MATERIALS AND METHODS

3.1 Groundnut Varieties

Fourteen newly developed groundnut varieties were produced by the Savanna Agricultural Research Institute (S.A.R.I.) were used for the studies. These were CS-49, ICGV-SM-89029, ICGV-92099, ICGV-86556, ICGV-88761, F-MIX⊕SINK-42, and F-MIX. The others were JL-24, CHINESE, ICGV-92101, ICGV-IS-96846, ICGV-91225, SINKARZIE and MANI-PINTAR. Table 1-3 give the agronomic properties.

Table 1: Performance of 12 lines at Nyapkala during 2001 season

LINE	D ff	Plants /plot	Plant height (SE)	Days to maturity	Pod Yield	Kernel Yield	Shelling Turnover %
CS-49	29.3	70.8	36.8±1.2	109.8±0.3	1628±33.5	1095±22	67.3
ICGV-SM-89029	28.8	82.0	33.5±0.33	112.5±0.32	2074.39±.74	1436±27	69.2
ICGV-86556	30.0	72.8	37.8±0.33	99.3±0.32	39.4±39.74	75515.1	56.4
ICGV-88761	28.0	64.3	34.5±0.33	101.5±0.33	1339±27.3	95920.4	69.6
F-MIX⊕SINK42	30.0	75.5	34.5±0.33	107±0.32	1374±30	1079±21	75.5
F-MIX	29.0	71.5	29.5±0.33	115.5±0.35	1429±28.4	1125±23	69.0
JL-24	28.3	81.0	42±0.33	99.5±0.3	1630±33.2	1080±20	84.7
CHINESE	27.5	70.5	45±0.33	99.3±0.31	1275±24.5	1207±24	75.5
ICGV-92101	30.3	77.3	42.5±0.33	101.5±0.23	1598±33	928±18	66.3
ICGV-IS-96846	29.3	67.0	36.5±0.33	103±0.23	1399±28	875±18	75.7
ICGV-91225	29.3	71.0	50.5±0.33	104±0.23	1156±247.4	1234±25	71.5
MANI PINTAR	26.8	76.8	55.5±0.3	113±0.23	1733±36.70	1108±22	73.9
Grand Mean	28.9	73.4	39.9	105.5±0.23	1500±30.0	1240±257.8	82.0
CV (%)	2.19	14.4	9.97	2.6	1512±31	17	
LSD (0.05)	0.91	15.2	5.7	3.9	17.3	248	

Table 2: Performance of 12 lines in Damango during 2001 season

LINE	D ff	Plants /plot	Days to maturity	Pod Yield	Kernel Yield	Haulm Yield	Shelling (%)
CS-49	37	44	110±0.2	1823±33.0	1560±51	3125±101	86
ICGV-SM-89029	37	47	110±0.2	1328±33.0	1086±34	3802±118	82
ICGV-86556	27	37	96±0.2	1042±33.0	807±28.0	1770±62	77
ICGV-88761	27	32	100±0.2	961±33.0	693±27.0	1823±70	72
F-MIX⊕SINK42	33	16	105±0.2	963±46	768±41.3	1354±72	80
F-MIX	36	47	110±0.2	1640±45.0	1416±44	3177±98.5	86
JL-24	25	40	95±0.2	1104±33.3	760±26	1614±55	69
CHINESE	27	37	96±0.2	818±25	637±22.3	833±30	78
ICGV-92101	29	46	96±0.2	1380±37	1096±35.0	1562±49	82
ICGV-IS-96846	32	39	105±0.2	1497±45.0	1289±44.0	2239±76	86
ICGV-91225	27	50	100±0.2	1536±41	1203±36.0	2604±14.1	78
MANI PINTAR	38	52	110±0.2	1406±37.0	1135±34	3125±93	81
Grand Mean	31	40	102±0.2	1292±39	1038±35	2252±66	80
CV (%)	3.8	32.5	1.2	19.0	21.5	21.4	
LSD (0.05)	1.7	18.8	1.78	169.5	154.2	332.6	

Table 3: Performance of 8 lines at Manga in the 2001 season

LINE	D ff	Plants /plot	Days to Maturity	Pod Yield	Kernel Yield	Haulm Yield	Shelling (%)
SINKARZIE	30.3±0.2	29.1±1	94±0.12	141±18.0	83±10.5	625±50	59
ICGV-88761	29±0.2	30	89±0.11	139±17.4	72±8.9	729±57	52
F-MIX⊕SINK42	31±0.20	27	98±0.13	681±90.4	470±61.5	1198±99	69
JL-24	28±0.1	39	89±0.10	537±59.0	380±42	1302±90	71
CHINESE	28±0.1	34	89±0.11	390±46.4	268±31.4	989±73	69

ICGV-92101	31±0.2	31	94±0.12	40.4±49.3	240±29	989±76	60
ICGV-IS-96846	30±0.15	36	96±0.11	635±75.0	399±45	104±75	63
ICGV-91225	30±0.2	31	93±0.12	344±42.4	189±23	937±70	55
Grand Mean	30±0.25	32	93±0.11	408±49.4	263±31	576±43.5	65
CV (%)	3.0	12.3	0.7	69	68	43	
LSD	1.3	5.8	1.0	198	126	297	

3.2 Measurement of physical parameters

The physical parameters assessed were the size, the hundred grain mass and colour using the methods as recommended by AACC (1983). The proximate composition parameters assessed were the fat content and the total protein content.

3.2.1 Size of grains

The size of each seed grain was determined by measuring three replicate lengths around the "equator"using a digimatic micrometer screw gauge (Mitutoyo Corporation).

3.2.2 Hundred kernel weight

The weight of 100 grains indicates the density of the grains. The sizes of the grains are small and there is variation in kernel size within a variety so one cannot take one or two grains and weigh them to establish their grain weight. Three sets of hundred grains are manually counted, using a Sartorius 120 top-loading balance weighed and the mean mass calculated and recorded for each variety of groundnuts.

3.2.3 Colour of grains

The CIELAB colour parameters L^*, a^* and b^* for the groundnut samples were measured with a chroma meter (Minolta CR310). The instrument was standardised each time with a white ceramic plate. The hue angles, h^*, representing the degree of

yellowness, and the Chroma (i.e. the brightness) were calculated from the following equations. (MacDougall.1988),

$$h^* = tan^{-1}(b^*/a^*)$$

$$Chroma = (a^{*2} + b^{*2})^{1/2}$$

where L*, a* and b* are colour parameters of the groundnut samples. The values used are the means of three measurements.

3.3 Determination of fat and protein content

3.3.1 Fat content of the groundnut varieties

The method of determination used is based on the principle of gravimetric extraction from a sample by a solvent followed by recovery of the fat by evaporation of the solvent.

40 grams of the grains was milled using a Cyclone sample mill (MS3010-017) and 10grams of the ground sample was placed in an oven-dried extraction thimble and covered with cotton wool to prevent them from splashing out. The thimble was then placed in a fat extraction apparatus. 100mL of the solvent (Petroleum ether) was poured into weighed flasks and placed on heating units connected to the fat extraction unit. The system was monitored carefully and the heat adjusted until mixture boiled moderately. After 4 hours, the heating unit was turned off and left to cool. The flasks were then moved and attached to a rotary evaporator and then into a drying oven to remove the last traces of solvent. The flask and its content was then finally weighed and recorded. The following formula was used in the calculation of the fat content.

$$\%Fat = \frac{B - A}{\text{Sample weight}} \times 100$$

Where B =Flask weight +fat (g) and A= Flask weight.

3.3.2 Protein content

Protein is one of the most important nutrients in foods. The protein content of grains can be affected by many different factors e.g., inherent qualities of the grain itself or management of the crop and agronomic conditions. It is thus useful to determine grain

protein content in order to ascertain the grain nutritional value, or to observe the effect of different treatments on its protein content.

The Kjeldahl analysis was employed in this work. The groundnut samples are ground using a Cyclone sample mill (MS3010-017). Organic nitrogen from the sample was converted to ammonium sulphate by digestion of the ground sample with concentrated sulphuric acid, using copper sulphate as catalyst. The ammonium is determined from the amount of ammonia liberated by the distillation of the digest with alkali. The ammonia liberated was collected in a volume of boric acid and determined in by titration using methylene red indicator with standard sulphuric acid.

The percent crude protein (%CP) in the sample was then calculated using the following formula (AACC):

$$\% \text{ CP} = \frac{(a)\,(b)\,(6.25)\,(100)}{c}$$

where a= normality of the acid, i.e., 0.5; b= volume of standard acid used (mL) ,corrected for blank; c= sample weight(mg) and 6.25=conversion factor for protein for % nitrogen.

Fig.1 100 grain mass

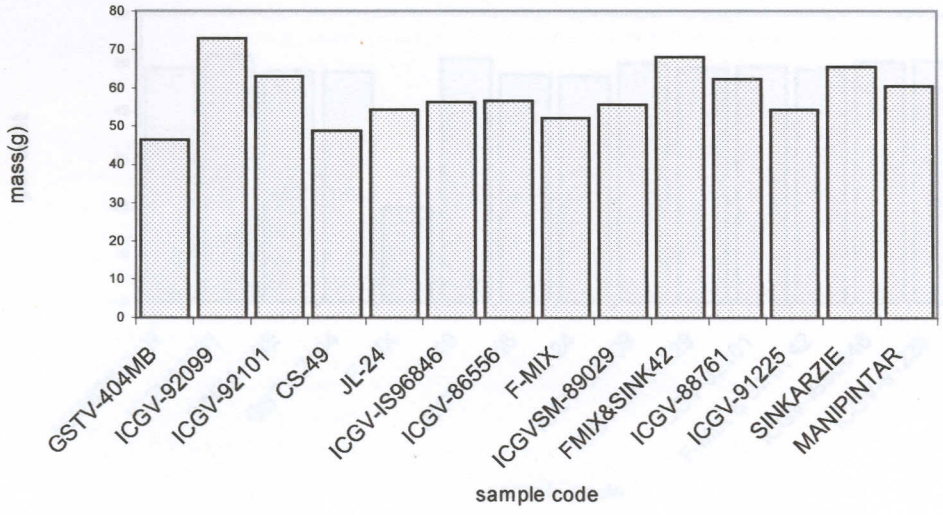


Fig. 2 Size of groundnut grains (mm)

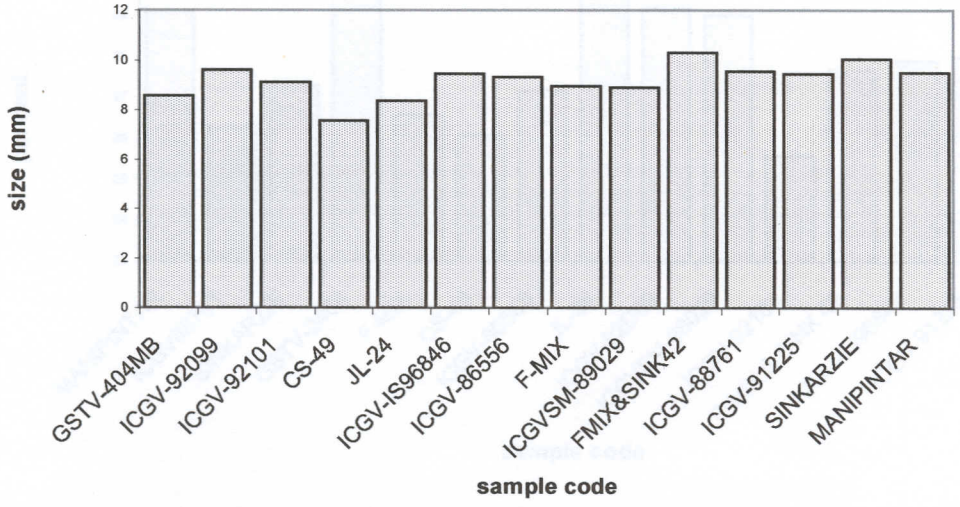


Fig.3 % Fat content

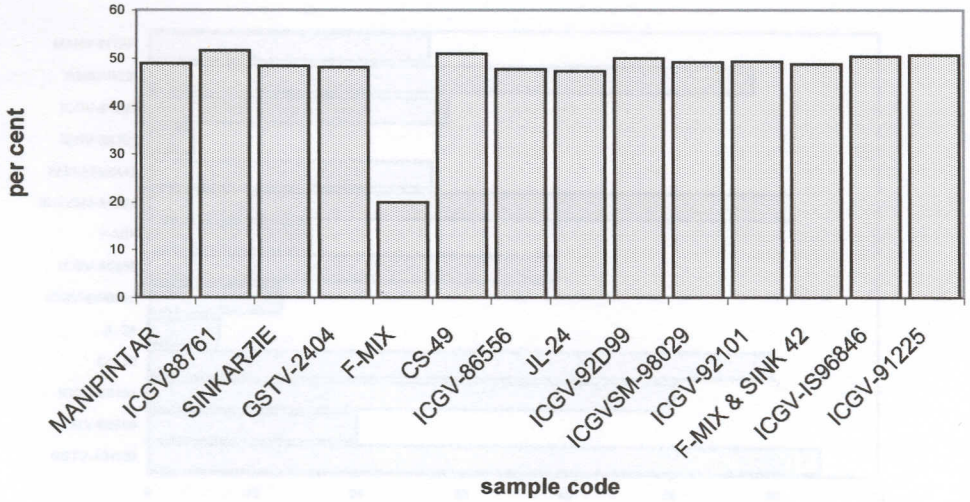


Fig.4 % Protein content

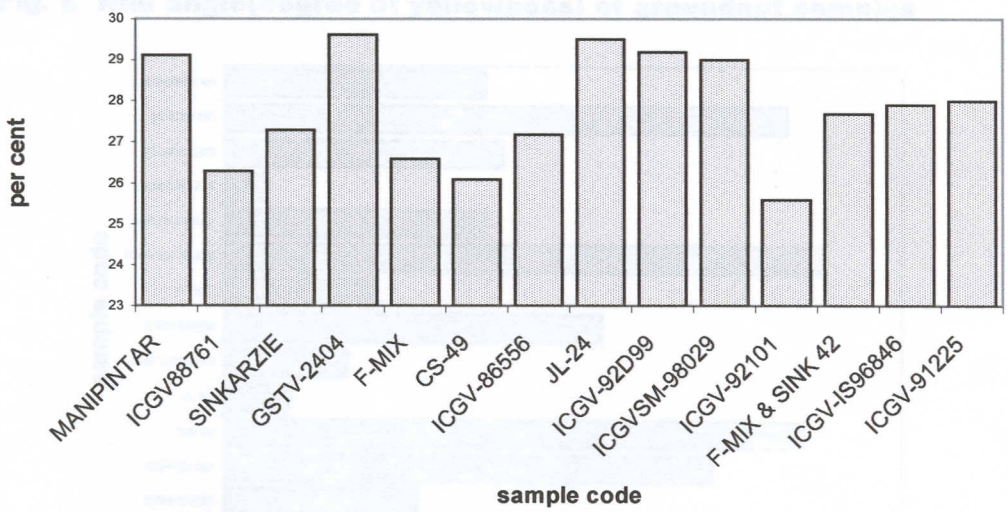


Fig. 5 (Chroma) Degree of brightness of groundnut samples

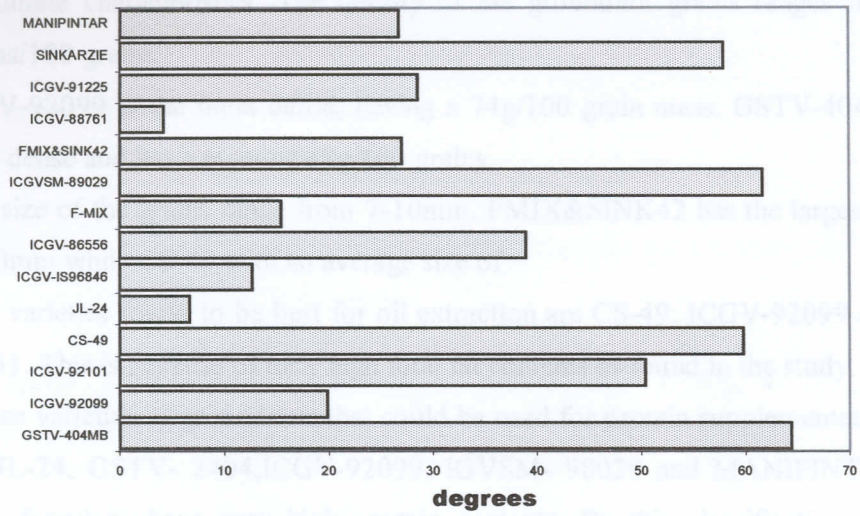
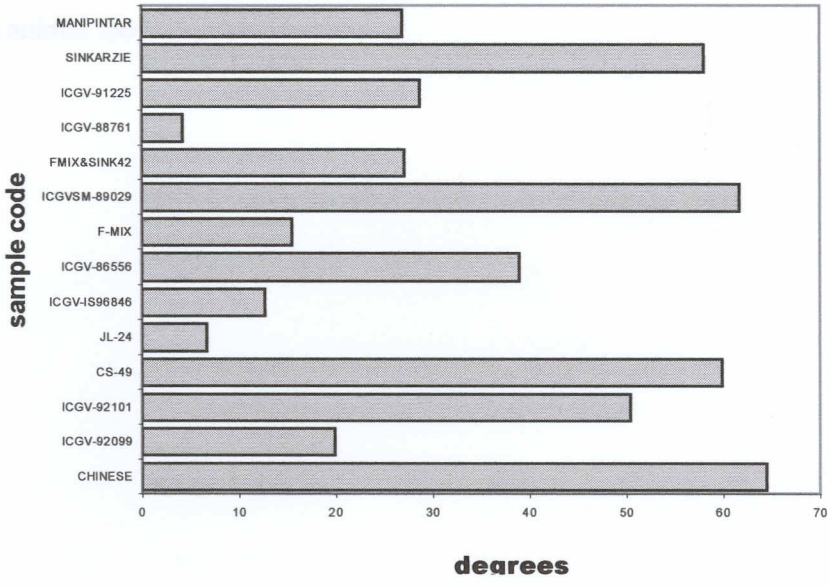


Fig. 6 Hue angle(degree of yellowness) of groundnut samples



CONCLUSION

The results of the study revealed that the groundnut samples had varying physical and proximate characteristics. The density of the groundnut grains ranges from 48-74 grams/100 grains.

ICGV-92099 is the most dense, having a 74g/100 grain mass. GSTV-404MB is the least dense and has a mass of 48g/100 grains.

The size of the grains range from 7-10mm. FMIX&SINK42 has the largest average e of 10mm while CS-49 with an average size of

The varieties found to be best for oil extraction are CS-49, ICGV-92099 and ICGV-88761. This is because of their high total fat contents as found in the study.

Those varieties of groundnuts that could be used for protein supplementation in diets are JL-24, GSTV- 2404,ICGV-92099, IGVSM- 98029 and MANIPINTAR. These were found to have very high protein contents. By this classification, ICGVSM-92099 satisfies both parameters and could be used protein supplementation in diets as well as for oil extraction. After extraction of oils from these high protein groundnuts, high-grade protein flours can be produced from the residual cake. These flours could be used as major sources of proteins in food formulations for infants and toddlers as well as in animal feed.

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