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Development of Low Cost Weaning Food by the Incorporation of Drumsticks Leaves Powder and Its Quality Analysis

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Abstract

The experiment was conducted to develop weaning food from drumstick leaf powder; soybean flour and barley flour blend for infants. The sample was formulated at different proportions. The quality of the prepared weaning food was determined on physicochemical characteristics namely: Moisture content, Ash content, protein content, fat content, Acid insoluble ash content and Chemical properties namely: Bulk density and water absorption capacity. And analyzed formulated sample were compared with control and recommended daily allowances (RDA).The Moisture content, Protein content, ash content of prepared weaning food increases with increasing drumstick leaf powder content. The weaning food prepared from sundried drumsticks leaf powder show higher moisture content than tray dry drumstick leaf powder .The mean overall sensory acceptability score are higher for 5g treatment than 10g-15g treatment of the weaning food prepared from sundried and tray dried drumsticks leaf powder, The three supplementary blends (5g, 10g, 15g) were formulated based on protein and energy of the food commodities .The overall result indicated that nutrient content nutrient content of all treatment 5-15 g blends in The range of 9.24-9.85% moisture, 2.76%-3.54% ash,16.36%-24.70% protein, and 6.13%-6.87% fat content. The difference was found between all means statistically significant (P< 0.05). The protein and Fat content 5g-10g were suitable for infants between the age group of 6 month 3 years as compared to recommended dietary allowances. In prepared weaning food T_3 (soy flour, barley flour, drumstick leaves powder, sugar and salt potato flour) was found cheaper (26.36 Rs. /Kg.)Than other treatment combination. The suggested technology was feasible
And also formulation with drumstick leaf powder can therefore be used as a weaning food to improve the nutritional status of children and also help solve problems associated with protein energy malnutrition among infant in developing countries in general.

Keywords- *Weaning food, Drumsticks leaf, Soya flour, Barley flour*

1. Introduction

India is a country with diverse agro-climatic conditions which favors the cultivation and availability of wide array of fruits and vegetables. India is the second largest producer of vegetables next to China accounting for about 10 percent of the world production **(Singh and Sagar 2008).** Green leafy vegetable and fruits are a rich source of micronutrients, though hardly 2% of the produce is processed and 30-40% is being wasted due to lack of processing and preservation facilities. There are many varieties of green leafy vegetables, which rich source of iron and other essential micronutrient, but they are discarded and are not use for human consumption.

Green leafy vegetables have shorter shelf life due to highest moisture content and rate of respiration .Hence these commodities go a waste, which in turn result in huge financial loss for the farmer. According to the ministry of food processing industries, Government. of India, the lack of processing and storage of fruits and vegetables result in huge wastage estimated at about 35 % value of which is approximately Rs.33000 crores for perishable and Rs15000 crores for non perishable annually. Green leafy vegetable and fruits are a rich source of micronutrients. Though India stands second position in vegetable and fruits production, hardly 2%of produce is processed and 30-40% is being wastage due to lack of processing and preservation infrastructure **(Adeyeye 2002).**

There are many varieties of green leafy vegetable, which are rich natural source of iron and other essential micronutrient, but they are discarded and are not used for human consumption. Drumsticks leaf (*M. oleifera*,) is one of them, which is easily available and is very rich in all the micronutrients, *M. oleifera, commonly* referred to simply *"Moringa",* is widely cultivated species of genus "*Moringa"* which is the only genus in the family "*Moringaceae"*. It is an exceptionally nutritious vegetable tree with variety of potentially use. The tree itself rather slender, with drooping branches that grows too approximately 10m in height. The drumstick tree grow is grow only in semi-arid, tropical and subtropical area. While it grows best in dry sandy

soil, it tolerates poor soil, including coastal area. It is fast – growing drought resistant tree that is native to the southern foothill of the Himalayas is north western India. The immature green pod called "drumsticks" is probably the most valued and widely uses part of the tree. They are commonly consumed in India and are generally prepared in similar fashion to green beans and have a slight asparagus taste.

Nutritionist are now trying to with encourages cultivation and incorporation of green leafy vegetable in various recipes with minimum effort and little cost, yielding a great benefit. Devising a several simple and acceptable micronutrient rich recipe containing green leafy vegetable would not only bring variety to the diet and but also helps in combating Vitamin A deficiency along with other micronutrient deficiencies. In developing countries where most of the people are engulfed in poverty and cannot afford the expensive food product and suffer from various diseases .a need to identify cheap and easily available source rich in micronutrient is essential. Though this study the less utilized leaf of *M.oleifera*, which are rich in micronutrient but are mostly discarded or go waste was researched on and the effect of different method of drying (sunshade and oven) on their nutritive value was assessed.

The drumsticks leaf can be used to cure a minimum of 300 diseases. It give referred more than 90 nutrient and 46 types of antioxidant in an extremely powerful tool in preventing diseases and the risk associated with malnutrition by providing nutritious supplements eradicating malnutrition is impoverished communities children, who consume drumsticks leaf powder ,increase their weight and their overall health. Pregnant women using the powder have recovered from anemia and had babies with higher birth weight. The power will also find suitable application in preparation of weaning food, ready to eat food ,instant Sāmbhar mix, soup powder juice ,chutney and pickle, drumsticks green tea and has projected demand in the Indian market ,These also act a "Nutraceuticals" **(Phanilkumar,2010)** The technique used in the preparation of drumsticks leaf is dehydration i.e. by oven drying shade drying and sun drying etc. Dehydration result in concentration of nutrients, and is one of the most possible strategy for preservation of green leafy vegetable which are highly seasonable and perishable too. Weaning food generally introduced between six month to three year old as Brest feeding is discontinued. Nutritional status in children is most vulnerable during the weaning stage when both macro and micronutrient may be insufficient to maintain growth and development. Protein energy and micronutrient under-nutrition occur together according to the level up to 10% .moisture 5-10% total ash not more than 5%. Weaning food inclusion of soybean in the diet is found to improve nutrient density intake, which result in the preservation of malnutrition problem **(Badamosi *et al.* 2000).** The weaning period represent a stage of rapid growth and development and the weaning diet must supply adequate energy in the carbohydrate and fat and also protein and essential vitamins and minerals.

2. Material and Methods

Drumsticks leaf, were obtained from campus of Queens College of food technology Aurangabad, Soy flour, Barely flour, sugar, salt was procured from local market of Aurangabad. It was sieved before used, stored in air tight container and kept room temperature.

2.1 Procedure:

The drumsticks leaves was selected by visual appearance of fresh and dark green colored and matured. The drumsticks leaves were was with clean water, and draining out excess of water, Blanching is carried out by addition of 2% salt solution, After blanching The drumsticks leaves allowed to drying by two method Tray drying and sun drying was done at temperature 35˚C-39˚C for 12 hours and tray drying was done at temperature 70˚C for 7 hours, After drying ground and sieves them, Then soy flour and barley flour, sugar and salt was added in the drumsticks leaves powder, and mixed all the ingredients. The prepared weaning food were packed into the LDPE bags and sealed with the help of sealing machine and well labeled. Packed weaning food was stored in the cool or dry place.

2.2 Chemical analysis of drumsticks leaves powder, soy flour and barley flour

2.2.1chemical Analysis:

2.2.1 Moisture: Estimation of moisture hot air oven method at 105^0 c for hrs **(By AOAC, 2000).**

2.2.2 Fat: Extracting the sample in a Soxhlet apparatus for 6-8 h using petroleum ether. The solvent is evaporated and the residue is weighed **(By AOAC 2000).**

2.2.3 Protein: The estimation of nitrogen is done by kjeldahl method where in the protein content is obtained by multiplying the nitrogen value with 6.25 **(By AOAC 2000).**

2.2.4 Ash: By using muffle furnace method up to constant weighs. Ignite in a muffle furnace at 550+/- 25^0c for 4 hrs **(By Ranganna, 1986).**

2.2.5 Acid insoluble ash: By using muffle furnace method up to constant weigh. The crucible were pre later preheated in the carbolated furnace at 550+/- 25^0c for 10 min **(By Ranganna, 1986).**

2.3 Physical Analysis:

2.3.1 Water absorption capacity: This was determined using the method given by **(Sosulski, 1962)**

2.3.2 Bulk density-This was determined using the method given by **(Okaka and Potter, 1977)**

2.3.3 Sensory evaluation: Evaluate the products for acceptability based on its flavour, texture, appearance, amount of bitterness and overall acceptability using nine-point hedonic scale (1 = dislike extremely to 9 = like extremely; **Meilgaard et al., 1999**)
.

2.3.4 Statistical analysis: Analyzed by two-way analysis of variance (ANOVA) and analysis is carried using Microsoft Excel (**By Gupta, 1997**).

.3. Result and Discussion

In this present study the weaning food was developed from different blends of flour of barley flour and soy flour with drumstick leaf powder. The soy flour, barley flour and drumstick leaf powder were analyzed for their proximate composition. The samples of weaning food were prepared according to drying

methods (Sun drying and tray drying and level of incorporation (5g, 10g, 15g) of drumstick powder.

3.1 Chemical Characteristics

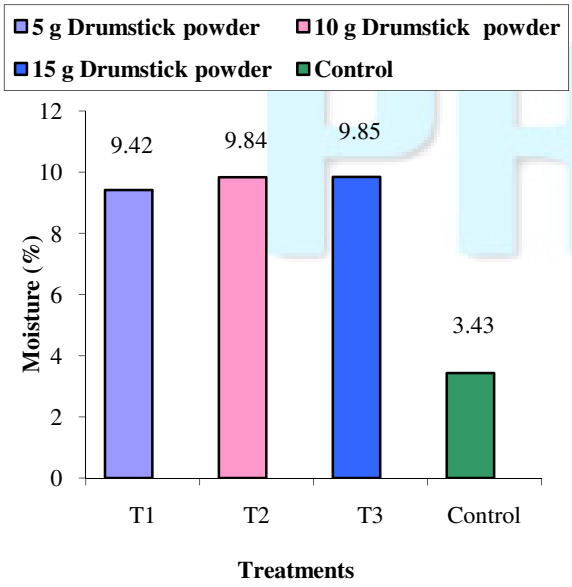
3.1.1 Moisture Content (Sun Dried)

Table 3.1.1 Moisture content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	3.1	3.8	3.4	3.2	3.4	3.38
T_1	9.71	9.12	9.23	9.09	9.99	9.42
T_2	9.77	9.73	9.8	9.98	9.98	9.84
T_3	9.87	9.9	9.54	9.84	10.12	9.85
F-test	S					
S.Ed. (±)	1.379					
C.D. (P=0.05)	2.938					

Table 3.1.1 shows the percent moisture content of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates the moisture values are higher in the entire sample compared to control (T_0) sample, on evaluation of result it was found that there was an increase in moisture content in the sample with increasing the level of drumstick leaf powder from 5g to 15g. The lowest moisture content 9.42% found in (T_1) sample. The highest moisture content 9.85% found in (T_3) sample. The moisture content of the products was all below 10% these values are lower enough to allow for good storage if packaged properly. The moisture content reduced exponentially as the drying time increased **(Doymaz 2007).** The moisture content of prepared weaning food is less than proximate moisture content of weaning food given by (IS-2000-2009) so it is suitable for processing.

From the ANOVA table it is evident the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on moisture content of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.



3.1.2 Moisture Content (Tray Dried)

Table 3.1.2 Moisture content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	3.1	3.8	3.4	3.2	3.4	3.38
T_1	9.89	9.66	9.04	9.86	9.04	9.49
T_2	9.87	9.81	9.55	9.41	9.07	9.54
T_3	9.32	9.17	10.02	10.01	10.1	9.72
F-test	S					
S.Ed. (±)	1.326					
C.D. (P=0.05)	2.825					

Table 3.1.2 shows the percent moisture content of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates the moisture values are higher in all the treatments compared to control (T_0) sample, on evaluation of result it was found that there was an increase in moisture content in the sample with increasing the level of drumstick leaf powder from 5g to 15g. The lowest moisture content 9.49% found in (T_1) sample. The highest moisture content 9.72% found in (T_2) sample .The moisture content of the products was all below 10% these values are lower enough to allow for good storage if packaged properly. The moisture content reduced exponentially as the drying time increased **(Doymaz 2007).** The moisture content of prepared weaning food is less than proximate moisture content of weaning food given by (IS-2000-2009) so it is suitable for processing.

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on moisture content of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

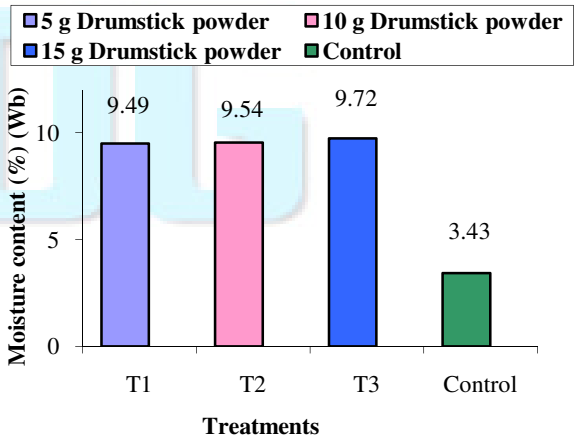


Fig. 3.1.2 Moisture content of prepared weaning food incorporating sundried drumstick leaf powder.

3.2.1 Ash Content (Sun Dried)

Table 3.2.1 Ash content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	4.5	4.04	3.89	3.99	4.01	4.08
T_1	2.52	2.53	3.44	2.86	2.47	2.76
T_2	3.12	3.47	3.86	3.99	3.27	3.54
T_3	2.83	3.35	2.95	.3.02	2.88	3.00
F-test	S					
S.Ed. (±)	0.330					
C.D. (P=0.05)	0.704					

Table 3.2.1 shows the percent ash content of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates that ash content values are lower in all the treatments compared to control (T_0) sample, on evaluation of result it was found that there was an increase in ash content in the sample with increasing the level of drumstick leaf powder from 5gto 15g The lowest moisture content 2.76% found in (T_1) sample. The highest moisture content 3.54% found in (T_2) sample. The ash content of prepared weaning food is less than proximate ash content of weaning food given by (IS-2000-2009) so it is suitable for processing and consumption. The ash content of sample is increasing with increase in drumstick leaf powder because drumstick leaf powder is a rich source of minerals. The decreases or increases in ash content of treatments is attributable to the dehulling process of soy bean and maize and this is very important since some for the anti-nutritive factors are deposited in the hull of these crops. Ash content of food samples is an indication of the minerals content in a particular sample.

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on ash content of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

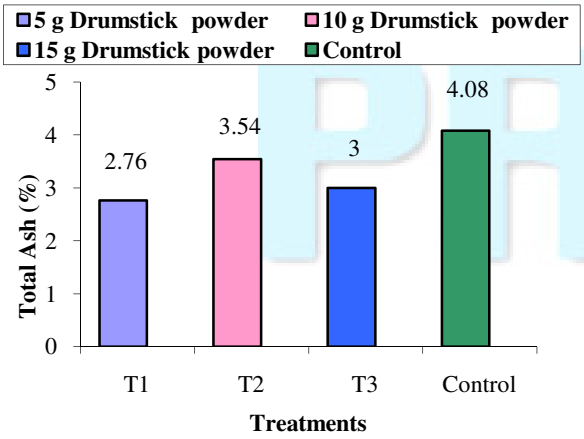


Fig. 3.2.1: Total Ash content of prepared weaning food incorporating sundried drumstick leaf powder.

3.2.2 Ash Content (Tray Dried)

Table 3.2.2 Ash Content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	4.5	4.04	3.89	3.99	4.01	4.08
T_1	2.26	2.58	3.75	2.33	3.05	2.79
T_2	3.38	3.09	3.24	3.37	3.46	3.30
T_3	3.66	2.68	3.68	3.44	3.13	3.38
F-test	S					
S.Ed. (±)	0.309					
C.D. (P=0.05)	0.660					

Table 3.2.2 shows the percent ash content of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates that ash content values are lower in all the treatments compared to control (T_0) sample, on evaluation of result it was found that there was an increase in ash content in the sample with increasing the level of drumstick leaf powder from 5g to 15g. The lowest moisture content 2.79% found in (T1) sample. The highest moisture content 3.38% found in (T_3) sample. The ash content of prepared weaning food is less than proximate ash content of weaning food given by (IS-2000-2009) so it is suitable for processing and consumption. The ash content of sample is increasing with increase in drumstick leaf powder because drumstick leaf powder is a rich source of minerals. The decreases or increases in ash content of treatments is attributable to the dehulling process of soy bean and maize and this is very important since some for the anti-nutritive factors are deposited in the hull of these crops. Ash content of food samples is an indication of the minerals content in a particular sample.

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on ash content of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

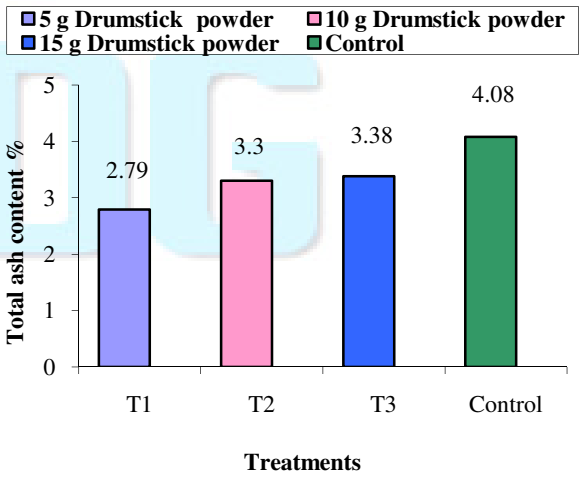


Fig. 3.2.2 Total Ash content of prepared weaning food incorporating tray dried drumstick leaf powder.

3.3.1 Fat Content (Sun Dried)

Table 3.3.1 Fat Content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	9.00	9.12	9.03	9.05	9.13	9.06
T_1	6.07	6.1	6.14	6.29	6.30	6.18
T_2	6.08	6.24	6.82	7.61	7.01	6.75
T_3	6.49	6.32	6.04	6.33	6.65	6.36
F-test	S					
S.Ed. (±)	0.589					
C.D. (P=0.05)	1.256					

Table 3.3.1 shows the percent fat content of different treatment with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates that fat content values are lower in all the treatments compared to control (T0) sample, on evaluation of result it was found that there was a significant and constant amount of fat content in all the treatments with increasing the level of drumstick leaf powder from 5g to 15g. The fat content of the blend were mainly provided by soybean and drumstick leaf powder. There is increasing level of the fat content is due to the increasing level of fat content is due to the increasing level of soy flour and drumstick leaf powder. Soybean and drumstick exhibited higher value of fat/oil content as compared with literature value of 17% and 5.34%, respectively **Dolcas (2008).** The lowest fat content 6.18% found in (T_1) sample. The highest fat content 6.75% found in sample (T_2). The fat content of prepared weaning food is less than proximate fat content of weaning food given by **(IS-2000-2009)** so it is suitable for processing and consumption.

The results of this project has been shown that soybean in formulated treatments is a good nutritional supplement because of its high protein and fat content for infant. In the processing of the soy flour the beans were not defatted and hence full of soybean flour was used in this study. As per recommendation of (Food Agricultural organization and World Health Organization, 1998) that vegetable oils be included in foods meant for infants and children, Because it provide essential fatty acids like that of n-3 and n-6 Polyunsaturated Fatty acid (PUFA) needed to ensure proper neural development. The fat content was highest in the shadow – dried (7.03%) and was lowest in sun-dried (6.98%) drumstick leaf powder (**Joshi and Mehta, 2010**).

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on fat content of control treatment (T_0) and experimental (T_1, T_2 and T_3) samples.

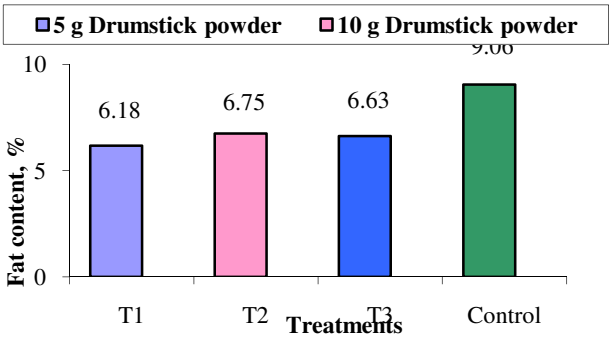


Fig. 3.3.1 Fat content of prepared weaning food incorporating sundried drumstick leaf powder.

3.3.2 Fat Content (Tray Dried)

Table 3.3.2 Fat content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	9	9.12	9.03	9.05	9.13	9.06
T_1	6.99	7.07	6.77	6.16	6.04	6.60
T_2	6.97	6.18	6.56	6.56	6.28	6.52
T_3	6.07	7.08	6.99	6.76	6.6	6.65
F-test	S					
S.Ed. (±)	0.608					
C.D. (P=0.05)	1.296					

Table 3.3.2 shows the percent fat content of different treatment with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates that fat content values are lower in all the treatments compared to control (T_0) sample, on evaluation of result it was found that there was a significant and constant amount of fat content in all the treatments with increasing the level of drumstick leaf powder from 5g to 15g. The fat content of the blend were mainly provided by soybean and drumstick leaf powder. There is increasing level of the fat content is due to the increasing level of soy flour and drumstick leaf powder. Soybean and drumstick exhibited higher value of fat/oil content as compared with literature value of 17% and 5.34%, respectively **Dolcas (2008).** The lowest fat content 6.52% found in (T_2) sample. The highest fat content 6.65% found in sample (T_3). The fat content of prepared weaning food is les tan proximate fat content of weaning food given by (IS-2000-2009) so it is suitable for processing and consumption.

The results of this project has been shown that soybean in formulated treatments is a good nutritional supplement because of its high protein and fat content for infant. In the processing of the soy flour the beans were not defatted and hence full of soybean flour was used in this study. As per recommendation of **(Food Agricultural organization and World Health Organization, 1998)** that vegetable oils be included in foods mean for Infants and children, Because it provide essential fatty acids like that of n-3 and n-6 Polyunsaturated Fatty Acid (PUFA) needed to ensure proper neural development. The fat content was highest in the shadow-dried (7.03%) and was lowest in sun-dried (6.98%) drumstick leaf powder **(Joshi and Mehta, 2010).**

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore, it can be included that significant effect of treatment on fat content of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

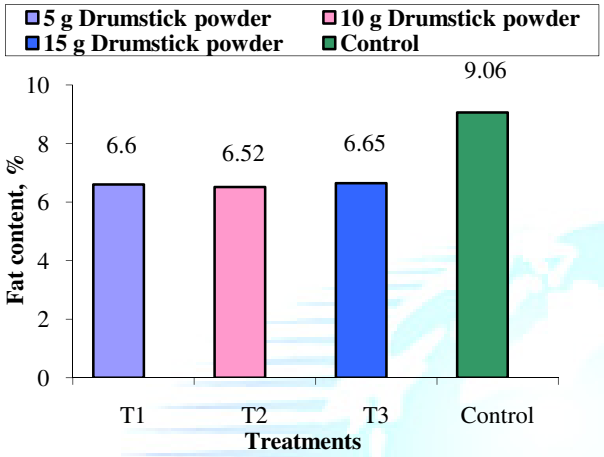


Fig. 3.3.2 Fat content of prepared weaning food incorporating tray dried drumstick leaf powder.

3.4.1 Protein Content (Sun Dried)

Table 3.4.1 Protein content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	15	15.11	15.09	15.06	15.11	15.07
T_1	17.14	16.78	16.87	17.43	16.81	17.00
T_2	23.87	22.27	22.56	24.06	23.87	23.32
T_3	24.18	24.36	24.25	24.93	24.61	24.46
F-test	S					
S.Ed. (±)	2.018					
C.D. (P=0.05)	4.301					

Table 3.4.1 shows the percent protein content of different treatments with control (T_0) and experimental sample (T_1, T_2, T_3). The results indicate that protein content values are higher in all the treatments compared to control (T_0) sample. On evaluation of result it was found that there was an increase in protein content in the treatments with increasing the level of drumstick leaf powder from 5g to 15g. The probable reason for the significant variation in protein among the treatments could be due to the ratio blend of soy flour and drumstick powder with increasing level from 5g to 15g. Both food commodities had been recommended for infant feeding Nnam (2002) due to their positive contribution to protein nutritional levels. The lowest protein content 17% found in (T_1) sample. The highest protein content 24.46% found in sample (T_3). The protein content of prepared weaning food is higher than proximate protein content of weaning food given by (IS-2000-2009) so it is suitable for processing and consumption. The protein content of treatments is increasing with increase in drumstick leaf powder. Soybean was also of particular interested as a vegetable protein source because of its cholesterol lowering abilities I patients with type II hyperlipoprotinamia **Loati *et al,* (2000).**

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on protein content of control sample (T_0) treatments and experimental (T_1, T_2, T_3) samples.

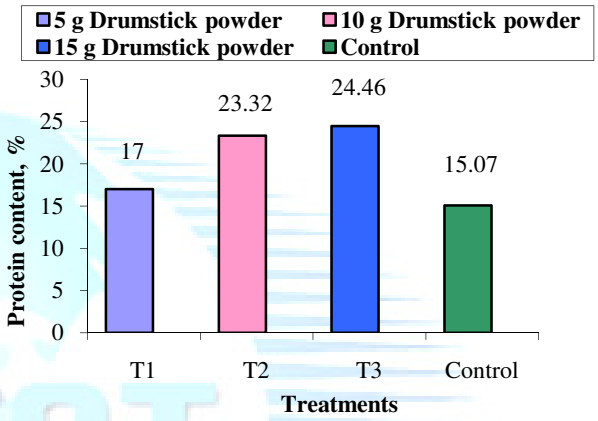


Fig. 3.4.1 Protein content of prepared weaning food incorporating sundried drumstick leaf powder.

3.4.2 Protein Content (Tray Dried)

Table 3.4.2 Protein content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	15	15.11	15.09	15.06	15.11	15.07
T_1	15.89	15.12	16.68	17.19	16.85	16.34
T_2	22.85	21.9	22.4	22.08	22.5	22.34
T_3	24.99	24.89	24.86	24.93	25.87	25.10
F-test	S					
S.Ed. (±)	2.088					
C.D. (P=0.05)	4.450					

Table 3.4.2 shows the percent protein content of different treatments with control (T_0) and experimental sample (T_1, T_2, T_3). The results indicate that protein content values are higher in all the treatments compared to control (T_0) sample. On evaluation of result it was found that there was an increase in protein content in the treatments with increasing the level of drumstick leaf powder from 5g to 15g The probable reason for the significant variation in protein among the treatments could be due to the ratio blend of soy flour and drumstick powder with increasing level from 5% to 15%.

The lowest protein content 16.34% found in sample (T_1). The highest protein content 25.10% found in sample (T_3). The protein content of prepared weaning food is higher than proximate protein content of weaning food given by (IS-2002-2009) so it is suitable for processing and consumption. The protein content of treatments is increasing with increase in drumstick leaf powder. Soybean was also of particular interested as a vegetable protein source because of its cholesterol lowering abilities in patients with type II hyperlipoproteinamia **Lovati *et. al,* 2002).**

From the ANOVA table it is evident that the calculated value due to treatments are greater than the table value at 5% probability level. Therefore it can be concluded that significant effect of treatments on protein content of control sample (T_0) treatments and experimental (T_1, T_2, T_3) samples.

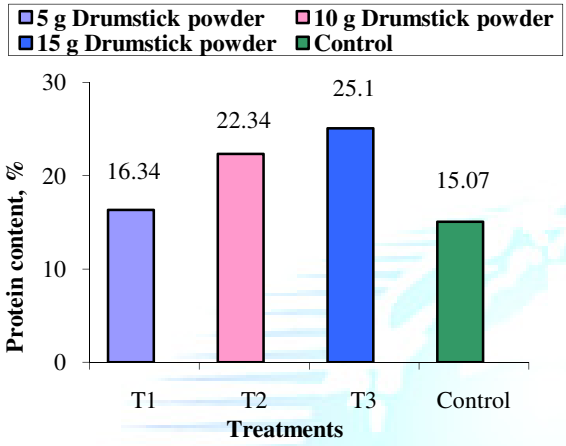


Fig. 3.4.2 Protein content of prepared weaning food incorporating tray dried leaf powder.

3.5.1 Acid Insoluble Ash (Sun Dried)

Table 3.5.1 Acid insoluble ash content of prepared weaning food.

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	0.185	0.179	0.179	0.181	0.179	0.180
T_1	0.048	0.099	0.148	0.196	0.148	0.127
T_2	0.14	0.106	0.099	0.197	0.148	0.138
T_S	0.099	0.143	0.193	0.143	0.195	0.154
F-test	S					
S.Ed. (±)	0.024					
C.D. (P=0.05)	0.051					

Table 3.5.1 shows the percent acid insoluble ash content of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates that acid insoluble ash content values are lower in all the treatments compared to control (T_0) sample. On evaluation for result it was found that there was an increase in acid insoluble ash content in the sample with increasing the level of drumstick leaf powder from 5g to 15g. The lowest acid insoluble ash content 0.127% found in sample (T_1). The Highest ash content 0.154% found in sample (T_3). The acid insoluble ash content of prepared weaning food is less than proximate ash content of weaning food given by **(IS-2000-2009)** so it is suitable for processing and consumption. The ash content of sample is increasing with increase in drumstick leaf powder because drumstick leaf powder is a rich source of minerals.

From the ANOVA table it is evident that the calculated value due to treatments are lower than the table value at 5% probability level. Therefore it can be concluded that there is no significant effect of treatments on acid insoluble ash contents of control treatment (T_0) and experimental (T_1, T_2 and T_3) samples.

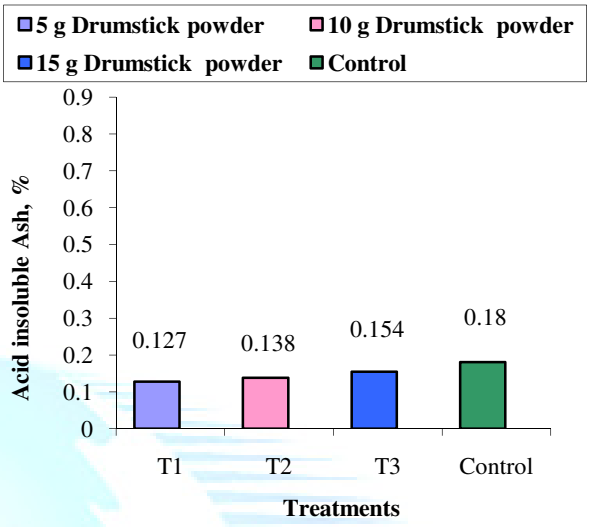


Fig. 3.5.1 Acid insoluble ash content of prepared weaning food incorporating sundried drumstick leaf powder.

3.5.2 Acid Insoluble Ash Content (Tray Dried)

Table 3.5.2 Acid insoluble ash content of prepared weaning food

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	0.185	0.179	0.179	0.181	0.179	0.180
T_1	0.058	0.099	0.0198	0.068	0.117	0.072
T_2	0.146	0.178	0.178	0.192	0.148	0.168
T_3	0.097	0.14	0.191	0.145	0.147	0.144
F-test	S					
S.Ed. (±)	0.023					
C.D. (P=0.05)	0.049					

Table 3.5.2 shows the percent acid insoluble ash content of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). The result indicates that acid insoluble ash content values are lower in all the treatments compared to control (T_0) sample. On evaluation for result it was found that there was an increase in acid insoluble ash content in the sample with increasing the level of drumstick leaf powder from 5g to 15g. The lowest acid insoluble ash content 0.72% found in sample (T_1). The Highest ash content 0.168% found in sample (T_3). The acid insoluble ash content of prepared weaning food is less than proximate ash content of weaning food given by (IS-2000-2009) so it is suitable for processing and consumption. The ash content of sample is increasing with increase in drumstick leaf powder because drumstick leaf powder is a rich source of minerals.

From the ANOVA table it is evident that the calculated value due to treatments are lower than the table value at 5% probability level. Therefore it can be concluded that there is no significant effect of treatments on acid insoluble ash contents of control treatment (T_0) and experimental (T_1, T_2 and T_3) samples.

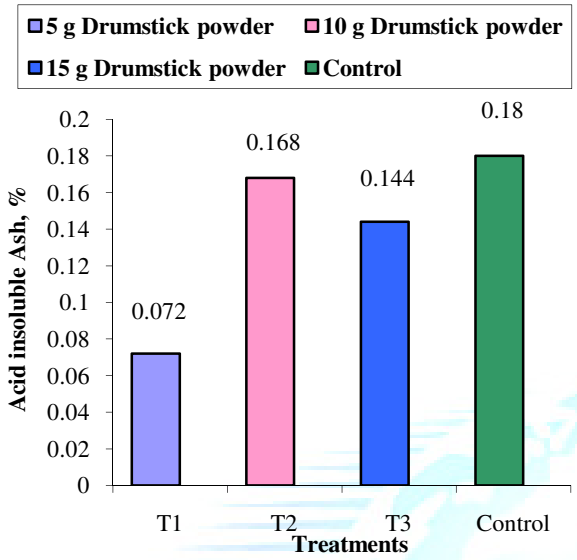


Fig. 3.5.2 Acid insoluble ash content of prepared weaning food incorporating tray dried drumstick leaf powder.

Physical Characteristics

3.6.1 Bulk Density (Sun Dried & Tray Dried)

Table 3.6.1 Bulk density for prepared weaning food from sun dried drumstick leaf powder.

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	0.65	0.62	0.61	0.60	0.60	0.61
T_1	0.6	0.66	0.55	0.6	0.58	0.59
T_2	0.66	0.6	0.56	0.61	0.63	0.61
T_3	0.59	0.61	0.63	0.58	0.61	0.60
F-test	S					
S.Ed. (±)	0.019					
C.D. (P=0.05)	0.041					

Table 3.6.1 shows the percent bulk density of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). There was a non-significant difference in bulk density. The highest value for bulk density found for T_2 sample (0.61). The probable reason for the variation in bulk density among the formulations attributed may be due to the per cent carbohydrate variations in the treatments. Bulk density depends on several molecular properties such as size, shape, flexibility and hydration of the protein. The result of the physical properties of the 5% treatments was in accordance with the value reported by **Kulkarni (1997)** they studied sorghum malted-based weaning food formulation.

From the ANOVA table it is evident that the calculated value due to treatments are lower than the table value at 5% probability level. Therefore it can be concluded that there is no significant effect of treatments on bulk density of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

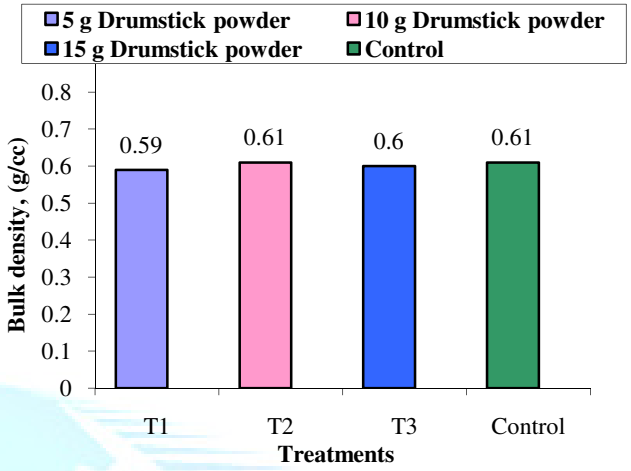


Fig. 3.6.1 Bulk density of prepared weaning food incorporating sundried drumstick leaf powder.

Table 3.6.2 Bulk density of prepared weaning food from tray dried drumstick leaf powder.

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	0.65	0.62	0.61	0.6	0.6	0.61
T_1	0.65	0.61	0.61	0.59	0.55	0.60
T_2	0.65	0.59	0.6	0.61	0.65	0.62
T_3	0.6	0.62	0.63	0.58	0.61	0.60
F-test	S					
S.Ed. (±)	0.017					
C.D. (P=0.05)	0.035					

Table 3.6.2 shows the percent bulk density of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). There was a non-significant difference in bulk density. The highest value for bulk density found for T_2 sample (0.62g). The probable reason for the variation in bulk density among the formulations attributed may be due to the per cent carbohydrate variations in the treatments. Bulk density depends on several molecular properties such as size, shape, flexibility and hydration of the protein. The result of the physical properties of the 5g treatments was in accordance with the value reported by **Kulkarni (1997)** they studied sorghum malted-based weaning food formulation. The lower the BD value, the higher the amount of flour particles that can stay together and thus increasing the energy content that could be derivable from such diets **(Onimawo and Egekun, 1998)**

From the ANOVA table it is evident that the calculated value due to treatments are lower than the table value at 5% probability level. Therefore it can be concluded that there is no significant effect of treatments on bulk density of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

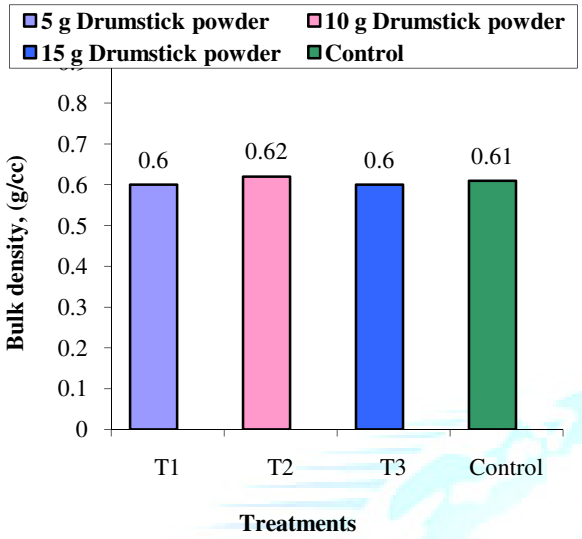


Fig. 3.6.2 Bulk density of prepared weaning food incorporating tray dried drumstick leaf powder.

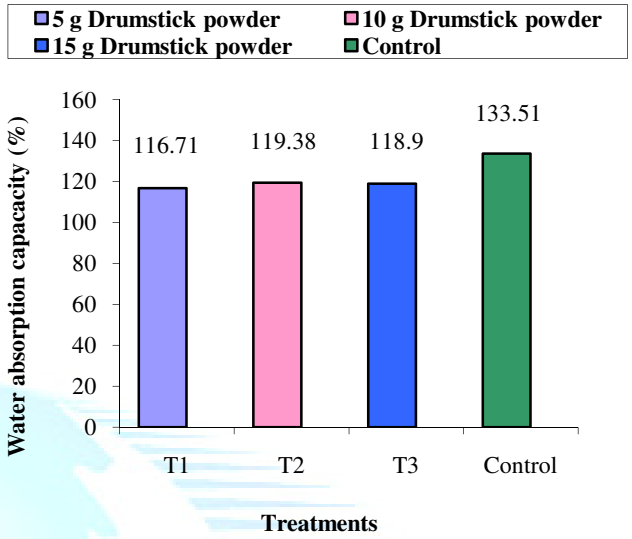


Fig. 3.7.1 Water absorption capacity of prepared weaning incorporating sundried drumstick leaf powder.

3.7.1 Water Absorption Capacity (Sun Dried And Tray Dried)

Table: 3.7.1 Water absorption capacity of prepared weaning food from sun dried drumstick leaf powder.

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	130	134	134.56	130	139	133.51
T_1	119.5	117.78	117	116.43	112.87	116.71
T_2	120.14	120.06	119.78	119.69	117.24	119.38
T_3	119	119.43	119.9	118.98	117.21	118.90
F-test	S					
S.Ed. (±)	4.249					
C.D. (P=0.05)	9.054					

Table 3.7.1 shows the percent water absorption capacity of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). There was a non-significant difference in water absorption capacity. The highest value for water absorption capacity found for T_2 sample. (119.38).

The probable reason for the significant variation in water absorption among the formulations could be due to carbohydrate contents. This trend was observed in the all treatments which exhibited low water absorption capacity low carbohydrate content decreased the water absorption capacity for most food systems **Dorosko and Rollins (2003).**

From the ANOVA table it is evident that the calculated value due to treatments are lower than the table value at 5% probability level. Therefore it can be concluded that there is no significant effect of treatments on water absorption capacity of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

Table 3.7.2 Water absorption capacity of prepared weaning food from tray dried drumstick leaf powder.

Treatment	Replication					Mean
	R1	R2	R3	R4	R5	
Control (T_0)	130	134	134.56	130	139	133.51
T_1	118.17	122.69	118.23	119.12	117.21	119.08
T_2	120.11	120	119.24	119.02	118.34	119.34
T_3	119.2	119.01	118.45	118.23	118	118.57
F-test	S					
S.Ed. (±)	3.900					
C.D. (P=0.05)	8.310					

Table 3.7.2 shows the percent water absorption capacity of different treatments with control (T_0) and experimental sample (T_1, T_2 and T_3). There was a non-significant difference in water absorption capacity. The highest value for water absorption capacity found for T_2 sample. (119.34).

The probable reason for the significant variation in water absorption among the formulations could be due to carbohydrate contents. This trend was observed in the all treatments which exhibited low water absorption capacity low carbohydrate content decreased the water absorption capacity for most food systems **Dorosko and Rollins (2003).**

From the ANOVA table it is evident that the calculated value due to treatments are lower than the table value at 5% probability level. Therefore it can be concluded that there is no significant effect of treatments on water absorption capacity of control sample (T_0) and experimental (T_1, T_2 and T_3) samples.

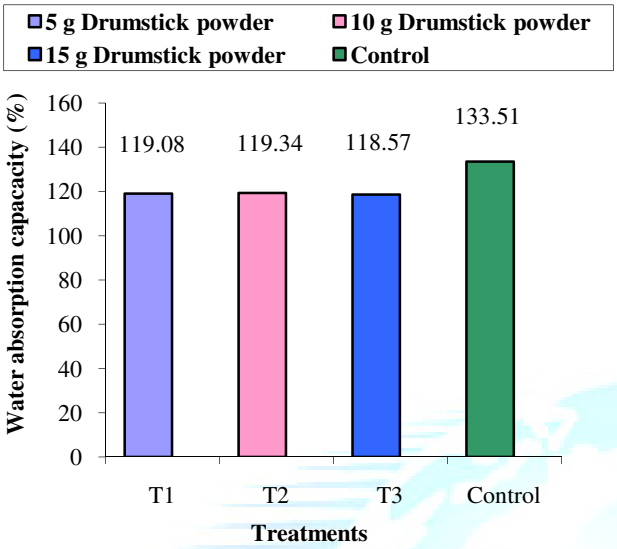


Fig. 3.7.2 Water absorption capacity of prepared weaning foods incorporating tray dried drumstick leaf powder

4. Conclusions

From the present study it can be concluded that weaning food prepared from 5g level of sun dried and tray dried drumstick leaf powder is highly acceptable than the weaning food prepared from 10g and 15g level of sun dried and drumstick leaf powder. The weaning food prepared from sun dried drumstick leaf powder is having slightly higher nutritional content than weaning food prepared from tried drumstick leaf powder and the mean overall sensory acceptability scores are higher for 5g treatments than 10g and 15g treatments of the weaning food prepared from both sun dried and tray dried drumstick leaf powder. And cost of product was also low rate.

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