International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-3, Issue-7, July 2017
ISSN: 2395-3470
www.ijseas.com

Physico-chemical and Sensory Qualities of Maize-*Ogi* Supplemented with Fermented *Moringa oleifera* Seed

[1]Jude-Ojei B.S, *[2]Ajala 'Lola [3]Ajayi I.O and [4]Emmanuel O.A, [5]Oni, S. S
[1]Department of Nutrition and Dietetics,
[2,4&5] Department of Food Science and Technology
[3]Department of Science Laboratory Technology
Rufus Giwa Polytechnic, Owo Ondo State Nigeria
* Corresponding author lola_ajala2006@yahoo.co.uk

Abstract

The effects of fermented Moringa seed flour supplementation on the functional properties and consumer acceptability of maize ogi was investigated. The ogi produced from maize was supplemented with fermented *Moringa* seed flour at substitution levels of 0, 10, 20 and 30%. The colour intensity, bulk density, foaming capacity, swelling capacity, least gelation, water and oil absorption capacity (WAC and OAC), emulsion capacity and stability and sensory properties (colour, specks, texture, flowage, grits, consistency, taste and Aroma) of the ogi samples were determined. There was an increase in the Colour intensity, Least gelation, Emulsion capacity and Emulsion stability with the inclusion of *Moringa* seed flour with values of 61.03,15.33,30.80 and 47.09% respectively. However, there was a notable decrease in values with the inclusion of *Moringa* seed flour in Bulk density, Swelling index, Foaming capacity, Water absorption capacity and Oil absorption capacity with values of 24.00,3.26,168.33 and 185.00% for 100% maize ogi sample respectively. The ogi sample with 10% fermented *Moringa* seed flour substitution was rated close to the 100% maize ogi sample in terms of colour, flowage, grits and consistency but was significantly ($p>0.05$) different from it in terms of specks, texture, taste and aroma. This study revealed that supplementation of ogi with fermented *Moringa* seed flour increased and improved the functional and sensory attributes of ogi samples.

Keywords

Functional properties; Acceptability; *Moringa* seed; supplementation.

1. Introduction

Maize (*Zea mays*) is one of the most widely grown staple food crop in Sub-Saharan Africa (SSA) occupying more than 33 million ha each year (1). The crop covers nearly 17% of the estimate 200 million ha cultivated land in SSA, and is produced in diverse production environments and consumed by people with varying food inclinations and socio-economic backgrounds. More than 300 million people in SSA depend on maize as source of food and livelihood. The top 20 countries, namely South Africa, Nigeria, Ethiopia, Tanzania, Malawi, Kenya, Zambia, Uganda, Ghana, Mozambique, Cameroon, Mali, Burkina Faso, Benin, DRC, Angola, Zimbabwe, Togo, and Cote d'Ivoire, account for 96% of the total maize production in SSA (1).

Maize or corn is a cereal crop that is grown widely throughout the world in a range of agro ecological environments. More maize is produced annually than any other grain. About 50 species exist and consist of different colours, textures and grain shapes and sizes. White, yellow and red are the most common types. The white and yellow varieties are preferred by most people depending on the region (2).

Moringa oleifera is an important underutilized traditional vegetable tree widely cultivated in India and many countries in tropical Africa. It is commonly known as drum stick tree or horseradish tree in English and locally known as *Zogale* among the Hausa-speaking people of

Nigeria. *Moringa oleifera* possesses many valuable properties, which is of great scientific interest. This includes the high-protein content (36.18%) in the seed which is not only abundant in good essential amino acids, but can be used to supplement cereal and tubers. It is also rich in fat and oil, provitamins, and minerals as compared to most fruits (3).

Moringa oleifera can be regarded as a versatile plant due to its numerous uses. The incorporation of *Moringa* seed flour into maize flour for making cookies has been reported. Different parts of the plant are edible and used as food. They include the leaves which are cooked and eaten like spinach, salad, or to make soup. The young green pods are boiled and eaten like green beans and the dry seeds are roasted and eaten like peas. *Moringa* seed is ground into flour and used domestically in soup seasoning and industrially used as a flocculating agent for water purification. Oil from the seed is used for cooking and as a solidifying agent in margarine production and other foodstuff that contain solid and semisolid fats thereby eliminating the hydrogenation process (3).

One of the popular indigenous fermented foods in Nigeria is *ogi* which is a fermented cereal porridge made from maize (*Zea mays*), sorghum (*Sorghum vulgare*) or millet (*Pennisetum typoideum*). The *ogi* porridge is very smooth in texture and has a sour taste reminiscent of that of yoghurt. In Nigeria, the uncooked *ogi* is either prepared into a smooth porridge called "pap" or a solid gel known as "eko" or "agidi. The consistency of the pap varies from thick to watery according to choice. The pap can be sweetened with sugar and milk; it is then eaten with bean cake. The pap is used as the first native food for weaning babies. It also serves as breakfast meal for pre-school, school children and adults. In a more concentrated form it is boiled into a thick gel and then allowed to set stiff in leaf moulds as "eko" or "agidi". In either form, it is usually preferred to many other indigenous foods by the aged and the convalescence (4).

This work is therefore aim at investigating the effect of *Moringa* seed flour supplementation on the functional and sensory properties of *ogi* that is nutritionally balanced and acceptable to consumers.

Materials and Methods

The yellow variety of maize grains used were purchased from *Ogbese* Market, *Ogbese*, Ondo state, Nigeria while the *Moringa* seeds were harvested from a residential compound at Emure-ile, Owo, Ondo state, Nigeria.

Production of *ogi*

The maize-*ogi* flour was prepared as described by (5)),(6)),(7)), by steeping clean maize grains in water at room temperature ($25^{+}2^{o}C$) for 48 hours. The steep water was decanted and the fermented grain was washed with clean water and then wet milled. The bran was removed by wet sieving with muslin cloth and the sieve was allow to settle and ferment for another 48 hours. The water was decanted and the cold maize gruel was pressed to remove water in it, the *ogi* was dried in a cabinet oven drier at $50^{o}C$ until a constant weight was achieved. It was cooled and packaged in an air-tight container for the analysis.

Preparation of fermented *Moringa* seed flour

The method described by (8) was adopted for the preparation of fermented *Moringa* flour with slight modification which was drying the fermented seeds before milling. Harvested *Moringa* seeds was dehulled and the fresh *Moringa* seeds was poured into a bowl and distilled water was added to the bowl. *Moringa* seeds were fermented for 48 hours at a room temperature $25 \pm 02°C$. At the end of the fermentation period, the seeds were washed with tap water, drained, and dried in a cabinet oven drier at 50°C for 36 hours. The dried seeds were then milled to flour and passed through 100 μm mesh size. The resultant flour was coded and stored in airtight containers and stored under ambient condition.

Determination of functional properties

Bulk density

The bulk density of the maize-*ogi* flour supplemented with fermented *Moringa* seed flour samples were determined according to the method described by (9). 50 g of the composite flour was put into a 100 ml graduated cylinder. The cylinder was tapped on the palm for 40 to 50 times and the bulk density was determined.

Colour intensity

The colour intensity was determined according to the method of (10). The degree of whiteness was determined using photometer, Model no C-300-3, Kett Electric Laboratory, China. About 50 g of sample was filled into the cuvette and inserted into the colour comparator and the degree of whiteness read off and recorded as percentage whiteness Kett scale calibration.

Foaming capacity

The method of (11) was employed in the determination of foaming capacity. Sample (1 g) was whipped with 50 ml distilled water for 5 minutes in a Kenwood blender at speed set at maximum and was poured into a 100 ml graduated cylinder. Total volume at time interval at 0, 5 minutes, 10 minutes until 1 hour was noted to study the foaming capacity.

Swelling index

The swelling index was determined using the method of (12). Twenty five grams of the each sample was weighed into a 210 ml measuring cylinder, 150 ml of water was added and allowed to stand for four (4) hours and the level of the swelling was observed thereafter.

Least gelation

The modified procedure of (11) was used to determined gelation properties. Appropriate sample suspension of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 g were prepare in 5 ml of distilled water each to make 2-20% suspension. The test tubes containing these suspensions were heated for 1 hour in boiling water (bath) followed by rapid cooling under running tap water. The test tubes were then cooled for 1 hour. The least gelation concentration was determined as concentration when the sample from the inverted test tube did not fall down or slip.

Water and oil absorption capacities

Water absorption capacity (WAC) of the samples were determined by a combination of AACC (13), (14) methods. Sample (1 g) was dispersed in 10 ml of distilled water. The content was mixed for 5 minutes on a magnetic stirrer or using glass rod. The mixture was centrifuged at 3500 rpm for 30 minutes and the volume of the supernatant left after centrifuging was noted. Water bound was calculated from the difference in volume of the initial volume of the water used and the final volume after centrifuging. The same procedure was used for oil absorption capacity (OAC), just that oil was used in place of water.

Emulsion capacity and stability

The emulsion capacity (EC) and stability (ES) was determined by the method of (15). 2 g sample, 20 ml distilled water and 20 ml soybean oil was prepared in a calibrated tube. The emulsion was centrifuged at 3,500 rpm for 30 minutes. The ratio of the height of the emulsion layer to the total height of the mixture was calculated as the emulsion activity expressed in percentage. The emulsion stability was estimated after heating the emulsion contained in a calibrated centrifuge tube at 80ºC for 30 minutes in a water bath, cooled for 15 minutes under running tap water and centrifuged after at 2000 rpm for 15 minutes. The emulsion stability expressed as a percentage was calculated as the ratio of the height of the emulsified layer to the total height of the mixture.

Sensory evaluation

Ogi was prepared by making the flour into slurry and heating it on fire with constant stirring using a clean stirrer until it forms a thick paste. The prepared *ogi* was then dished into sensory evaluation cups labelled randomly. Sensory evaluation of the *Moringa*-maize *ogi* blend samples was carried out by trained and semi-trained panel of twenty people comprising of Staff of Student of Rufus Giwa Polytechnic, Owo. It was served hot on randomly coded sensory evaluation cups. The parameters tested for are Colour, Specks, Texture, Flowage, Grits, Consistency, Taste and Aroma using descriptive test.

Statistical analysis

The data were analysed using SPSS version 16.0 (SPSS Inc., Chicago, IL). The mean and standard deviation of means of the samples were calculated. Analysis of variance was performed to determine significant differences between the means, while the means were separated using the new Duncan multiple range test and $P < 0.05$ was applied to establish significant differences.

Results and Discussion

Functional properties of composite flours.

Parameters	MO	MMO1	MMO2	MMO3
BD (g/cc)	0.58^{a}	0.60^{a}	0.61^{a}	0.60^{a}
CI (%)	61.03^{a}	56.33^{b}	55.10^{c}	51.66^{d}
SI (%)	24.00^{b}	32.33^{b}	56.00^{a}	65.33^{a}
LG (%)	15.33^{a}	11.33^{b}	6.67^{c}	4.67^{c}
FC (%)	3.26^{c}	7.18^{bc}	16.33^{ab}	24.83^{a}
EC (%)	30.80^{a}	25.21^{b}	22.21^{c}	21.76^{c}
ES (%)	47.09^{a}	35.84^{b}	32.52^{c}	33.53^{bc}
WAC (%)	168.33^{b}	180.00^{ab}	200.00^{ab}	210.00^{a}
OAC (%)	185.00^{b}	190.00^{b}	223.33^{a}	243.33^{a}

KEYS---BD-Bulk density CI-Colour Intensity SI-Swelling index LG-Foaming Capacity EC-Emulsion Capacity ES-Emulsion Stability WAC-Water Absorption Capacity OAC-Water Absorption Capacity.

Functional properties

The results of the bulk density showed that sample with 10% *Moringa* seed flour has the lowest value (0.60) among the *Moringa* maize-*ogi* blend. Since it has a low bulk density, it would be an advantage in the formulation of complementary foods (16).The bulk density of flour samples influences the amount and strength of packaging material, energy density, texture, and mouth feel (17).

The colour of the *Moringa* seed changes during processing may be as a result of fermentation. Maize-*ogi* has 61.03 degree of whiteness which is significantly higher than 10%, 20% and 30% *Moringa* maize-*ogi* with the values of 56.33, 55.10 and 51.66 respectively. The degree of whiteness of the *Moringa* maize-*ogi* decreases as the percentage of *Moringa* seed substitution increased in the *ogi* samples. The degree of whiteness of all samples varied significantly from one another. From this study, substitution of fermented *Moringa* seed in maize-*ogi* influenced the colour of the intensity.

The values reported for swelling Index (SI) of the *Moringa* maize-*ogi* was 24.00, 32.33, 56.00 and 65.33 for 100%, 90%, 80% and 70% maize-*ogi* respectively. The results showed that there is no significant (p>0.05) difference between samples prepared from 0% and 10% *Moringa* seed flour substitution and samples prepared from 20% and 30% *Moringa* seed flour substitution, sample with 30% *Moringa* seed flour substitution has the highest value (65.33) which is significantly (p<0.05) different from other samples while sample with 100% maize-*ogi* has the lowest value (24.00). The increase in the swelling power could be due to the high protein content of the *Moringa* seed flour, which has high affinity for water molecules (18)

The values reported for least gelation (LG) of the *Moringa* maize-*ogi* was 15.33, 11.33, 6.67 and 4.67 for 100%, 90%, 80% and 70% maize-*ogi* respectively. There was a decrease in the least gelation (LG) results with increase in *Moringa* seed flour. The maize-*ogi* that is higher in starch have the highest value. Thus the ability of flours to absorb water and swell is an important factor in the choice of soup thickeners. The values are significantly ($p<0.05$) different except for samples with 20% and 30% *Moringa* seed flour substitution which are not significantly ($p>0.05$) different from each other.

The values reported for Foaming Capacity (FC) of the *Moringa* maize-*ogi* was 3.26, 7.18, 16.33 and 24.83 for 100%, 90%, 80% and 70% maize-*ogi* respectively.100% *ogi* has the lowest Foaming Capacity (FC) with the value (3.26) which is significantly different from samples with 20% and 30% *Moringa* seed flour substitution while the sample with 30% *Moringa* flour substitution as the highest value (24.83). The highest foaming capacity is due to higher protein content of the sample. Protein in the dispersion may cause a lowering of the surface tension at the water air interface, thus always been due to protein which forms a continuous cohesive film around the air bubbles in the foam (19).

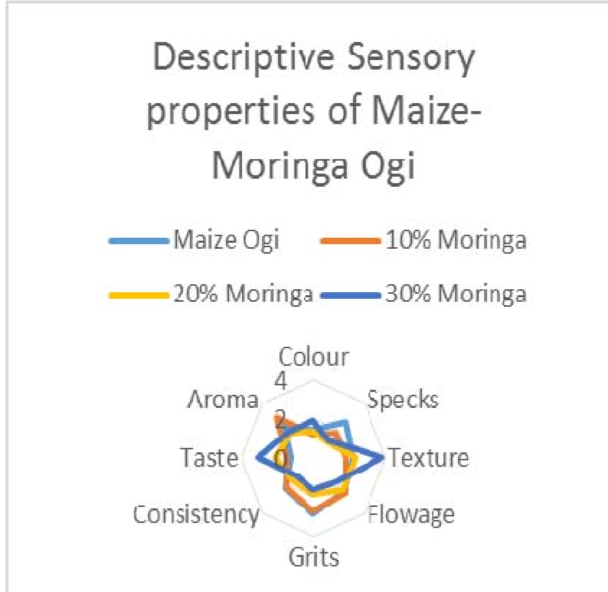
The values reported for Emulsion Capacity (EC) of the *Moringa* maize-*ogi* was 30.80, 25.21, 22.21 and 21.76 for 70%, 90%, 80% and 100% maize-*ogi* respectively. There was an increase in the Emulsion capacity (EC) with increase in *Moringa* seed flour. The values are significantly ($p<0.05$) different from each other except for samples with 20% and 30% *Moringa* flour substitution which were not significantly ($p>0.05$) different from each other. Hydrophobicity of protein has been attributed to influence their emulsifying properties (19). These properties are influenced by many factors among which are solubility, pH and concentration. The capacity of protein to enhance the formation and stabilization of emulsions is important for many applications in food products like cake, coffee whiteners and frozen desserts. In these products, varying emulsifying and stabilizing capacity are required because of their various compositions and processes (20)

The values reported for Emulsion Stability (ES) of the *Moringa* maize-*ogi* was 47.09, 35.84, 32.52 and 33.53 for 70%, 90%, 80% and 100% maize-*ogi* respectively. 30% *Moringa* maize-*ogi* has the highest value of Emulsion Stability (ES) (47.09) which was significantly ($p<0.05$) different from the other blends of the *Moringa* maize-*ogi*, samples with 0% and 10% *Moringa* seed flour substitution have no significant ($p<0.05$) difference while samples with 0% and 20% *Moringa* seed flour substitution were also insignificantly ($p>0.05$) different from each other. Increasing emulsion activity (EA), emulsion stability (ES) and fat binding during processing are primary functional properties of protein in such foods as comminute meat products, salad dressing, frozen desserts and mayonnaise.

The values reported for Water Absorption Capacity (WAC) of the *Moringa* maize-*ogi* was 168.33, 180.00, 200.00 and 210.00 for 100%, 90%, 80% and 70% maize-*ogi* respectively. In the Water Absorption Capacity (WAC) results showed that samples with 10%, 20% and 30% *Moringa* seed flour substitution were not significantly ($p>0.05$) different from each other. However, the sample with 30% *Moringa* flour substitution has the highest value (210), The high water absorption capacity observed in the 30% *Moringa* maize-*ogi* flour could be due to the high protein content of the *Moringa* seed flour which has high affinity for water molecules (18). Water absorption capacity or characteristics represent the ability of a product to associate with water under conditions where water is limited (21). This increase could also be due to the presence of higher amount of carbohydrates (starch) and fibre in this flour. Water absorption capacity is a critical function of protein in various food products like soups, dough and baked products (22). The water absorption capacity of flour is useful in determining the suitability of the material in baked flours (23).

The values reported for Oil Absorption Capacity (OAC) of the *Moringa* maize-*ogi* were 185.00, 190.00, 223.33 and 243.33 for 100%, 90%, 80% and 70% maize-*ogi* respectively. The results showed that the sample with 30% *Moringa* flour substitution has the highest value (243.33) which is significantly ($p<0.05$) different from other samples except for sample with 20% substitution which has no significant ($p>0.05$) difference from it. The water and oil binding capacity of food protein depend upon the intrinsic factors like amino acid composition, protein conformation and surface polarity or hydrophobicity. Having the highest OAC could be therefore being better to other samples as flavour retainer. The ability of the proteins of these flours to bind with oil makes it useful in food system where optimum oil absorption is desired. This makes flour to have potential functional uses in foods such as sausage production. The OAC also makes the flour suitable in facilitating enhancement in flavour and mouth feel when used in food preparation. Due to these properties, the protein probably could be used as functional ingredient in foods such as whipped toppings, sausages, chiffon dessert, angel and sponge cakes etc.

The results of the descriptive sensory qualities, maize-*ogi* was described as creamy yellow with few specks in appearance. Other sample with *Moringa* substitution were described as dirty white with specks. The colour of *ogi* largely depends on the type of cereal grain used in the production: cream-white for maize, reddish brown for sorghum, and dirty grey for millet (24). The results showed that the sample with 10% *Moringa* seed flour substitution was rated close to the sample with 0% substitution in terms of colour, flowage, grits and consistency but was significantly ($p>0.05$) different from it in terms of specks, texture, taste and aroma.



Conclusion

Among the *ogi* prepared from substituted samples, the sample with 10% *Moringa* seed flour substitution was most preferred in terms of colour, specks, grits, consistency, taste and aroma. Fortification with fermented *Moringa* seed flour improved the taste and aroma of *ogi*; a change which may be due to the pleasant flavour of fermented *Moringa* seed flour. The sample with 10% *Moringa* seed substitution had comparable sensory properties with unsupplemented samples. This could mean that an acceptable *Moringa* supplemented *ogi* can be produced at 10% level of subscription.

Acknowledgement

This Research was sponsored by Tertiary Education Trust Fund and we appreciate the sponsorship. I also acknowledge the effort of Dr. (Mrs.) Ajala Lola for guidance and effort for the completion of this research work.

References

(1) FAOSTAT. http://Faostat.fao.org (accessed October 6, 2015). 2012.

(2) IITA (International Institute of Tropical Agriculture) 2009. Maize.

(3) O.O. Oloyede, S.James ,O.B, Ocheme, C.E Chinma. And V.E Akpa. Effects of fermentation time on the functional and pasting

properties of defatted *Moringa oleifera* seed flour. Food Science Nutrition, 4: 89–95. doi:10.1002/fsn3.262. 2016

(4) M. Adebukunola . A.M Omemu, O. Mobolaji, Bankole. Consumer's Knowledge, Attitude, Usage and Storage Pattern of *Ogi* – A Fermented Cereal Gruel in South West, Nigeria. Food and Public Health 2015, 5(3): 77-83 DOI: 10.5923/j.fph.20150503.03.

(5) I.A, Akinrele. Fermentation studies on maize during preparation of a traditional African starch- cake food. J. Sc. Food Agric. 21:619-625. 1970

(6) H.G Muller. Manufacture of *Ogi* (a Nigerian fermented cereal porridge): Comparative evaluation of corn, sorghum and millet. Can. Inst. Food Science Technology Journal 5: 217-221. 1972a.

(7) J.O Akingbala, L.W Rooney, J.A Faubion . A laboratory procedure for the preparation of *Ogi*, a Nigerian fermented food. Journal of Food Sci. 46: 1523-1526. 1981.

(8) F. Oluwafemi., and M. C. Ikeowa. Fate of aflatoxin B_1 during fermentation of *Ogi*. Nigeria Food Journal 23:243–247. 2005

(9)J.C Okaka,and N.N Potter. Physicochemical and functional properties of cowpea powders processed to reduce beany flavour. Journal of Food Science, 44: 1235-1240. 1979

(11) A.W Coffman, V,V Garcia. Functional properties and amino acid content of protein isolate from mung bean flour. Journal of food technology, 12: 473 – 484. 1977.

(12) U.J Ukpabi and C.Ndimele. Evaluation of the quality of gari produced in Imo State, Nigeria, Nigerian Food Journal 8:105−110. 1990

(13) AACC. Approved methods of the American Association of cereal chemists (10th)
St Paul, MN: America Association of cereal chemist. 2002

(14)S.K Sathe.,S.S Deshpande and D.K Salunkhe .Functional properties of lupin seed (*Lupirinus nutabilis*) Proteins and Protein concentrates. Journal of Food Science 47:491–497. 1981

(15)K. Yasumatsu,K; Sawada S. Maritaka J. Toda T. Wada K. Ishi . Whipping and emulsifying properties of soy bean products. Agricultural Biology Chemistry 36:719-727. 1972

(16) M.I Akpata, P.I Akubor. Chemical composition and selected functional properties of sweet orange (*Citrus sinensis*) seed flour. Plant Foods Human Nutrition, 54: 353-362. 1999

(17)E.A Udensi, and K.A. Okoronkwo. Effect of fermentation and germination on the physicochemical properties of *mucuna cochinchinensis* protein isolate. African Journal of Biotechnology. 5:896–900. 2006

(18) A.A Yusuff, , H .Ayedun and L. O. Sanni. Chemical composition and functional properties of raw and roasted Nigerian benniseed (*Sesamum indicum*) and Bambara groundnut (*Vigna subterranean*). Food Chemistry Journal. 111:227–282. 2008.

(19) P. Kaushal, V. Kumar, H.K Sharma. Comparative study of physico-chemical, functional, anti-nutritional and pasting properties of taro (*Colocasia esculenta*), rice (*Oryza sativa*), pegion pea (*Cajanus cajan*) flour and their blends. LWT-Food Science Technology 48:59-68, 2012.

(20) Y.A Adebowale, I.A Adeyemi, A.A Oshodi . Functional and physic-chemical properties of six Mucuna species. African Journal of Biotechnology 4(12):1461-1468 2005.

(21) U Singh. Functional properties of grain legume flours. J. Food Sci. Technol. 38:191-199. 2001

(22) E.I Adeyeye and P.A Aye. The effect of sample preparation on proximate composition and the functional properties of African yam

bean flours. Note 1 La Rivista Italiana Della Sostanze Grasse, LXXV-Maggio. pp. 253-261.1998.

(23) J.P Nath, M. S Narasinga. Functional properties of guar proteins. Journal of Food Science 46: 1255, 1981

(24)O.O Onyekwere ,I.A Akinrele and O.A Koleoso. . Industrialization of *ogi* fermentation. In: Industrialization of Indigenous Fermented Foods. 33, 329-362. 1989

title. These lines should be 9 points Times New Roman.

Keywords: From 4 to 6 keywords should follow the abstract (as a subheading: *Key words*, of the Abstract).

Illustrations or pictures: All illustrations or pictures should be clear black and white prints. Supply the best quality illustrations or pictures possible.

2.1 Footnotes

Footnotes should be typed in singled-line spacing at the bottom of the page and column where it is cited. Footnotes should be rare.

3. Tables, Figures and Equations

3.1 Tables and Figures

To insert "Tables" or "Figures", please paste the data as stated below. All tables and figures must be given sequential numbers (1, 2, 3, etc.) and have a caption placed below the figure ("FigCaption") or above the table("FigTalbe") being described, using 8pt font and please make use of the specified style "caption" from the drop-down menu of style categories

Table 1: Margin specifications

Margin	***A4 Paper***	US Letter Paper
Left	18.5 mm	14.5 mm (0.58 in)
Right	18mm	13 mm (0.51 in)

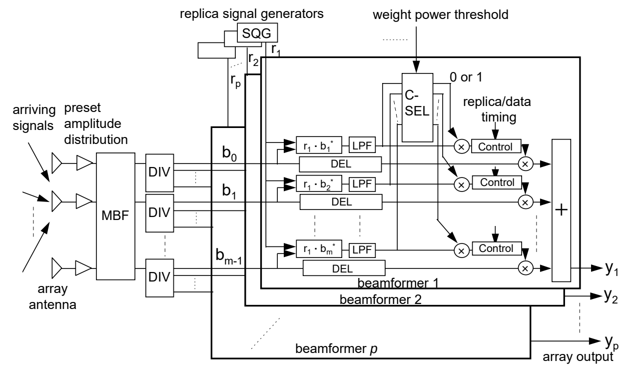


Fig. 1 Proposed beam former.

3.2 Equations

All equations must be typed or written neatly in black. They should be numbered consecutively throughout the text. Equation numbers should be enclosed in parentheses and flushed right. Equations should be referred to as Eq. (X) in the text where X is the equation number. In multiple-line equations, the number should be given on the last line.

$$y_i(N) = \sum_{n=0}^{m-1} w_n(N) b_n(N)$$
$$= \sum_{n=0}^{m-1} \overline{b_n^*(N) r_i(N)} \cdot b_n(N) \qquad (1)$$

4. Conclusions

The better your paper looks, the better the Journal looks. Thanks for your cooperation and contribution.

Appendix

Appendixes, if needed, appear before the acknowledgment.

Acknowledgments

Insert acknowledgment, if any. Sponsor and financial support acknowledgments are also placed here.

References

[1] A. A. Name, and B. B. Name, Book Title, Place: Press, Year.

[2] A. Name, and B. Name, "Journal Paper Title", Journal Name, Vol. X, No. X, Year, pp. xxx-xxx.

[3] A. Name, "Dissertation Title", M.S.(or Ph.D.) thesis, Department, University, City, Country, Year.

[4] A. A. Name, "Conference Paper Title", in Conference Name, Year, Vol. x, pp. xxx-xxx.

First Author Biographies should be limited to one paragraph consisting of the following: sequentially ordered list of degrees, including years achieved; sequentially ordered places of employ concluding with current employment; association with any official journals or conferences; major professional and/or academic achievements, i.e., best paper awards, research grants, etc.; any publication information (number of papers and titles of books published); current research interests; association with any professional associations. Do not specify email address here.

Second Author biography appears here. Degrees achieved followed by current employment are listed, plus any major academic achievements. Do not specify email address here.