

## Investigations into the Trace element variations in Wheat grains by Hand held X-ray Fluorescence

Daisy Joseph<sup>1,\*</sup>, A.S.Shitre<sup>2</sup>, B.K.Das<sup>2</sup>,

<sup>1</sup>Nuclear Physics Division, Bhabha Atomic Research Centre, Mumbai - 400085, INDIA

Nuclear Agriculture and Biotechnology Division,  
Bhabha Atomic Research Centre, Mumbai - 400085, INDIA

\* email: djoseph@barc.gov.in

### Introduction

Wheat of different genotypes was analyzed for their micro and macronutrient contents using HHXRF. It was found that K and Ca was present in significant quantities and besides other trace elements Fe and Zn were present showing a positive trend for crop improvement programme. Since wheat is Indian staple food, the objective was to find the Fe and Zn content in each of these genotypes to have high yielding nutritionally superior genotypes (1)

Five different genotypes of wheat whole wheat, machine powdered and finely powdered by pestle and mortar were analyzed for the trace elemental contents for comparison using HHXRF

### Experimental Techniques

Hand held XRF (HHXRF) is the need of the hour to analyze metals, powders and alloys, as other conventional XRF techniques are found to be cumbersome and difficult to handle(2). So to test the efficiency of the HHXRF a wheat powder which was used as a test sample was analyzed to detect the trace elements. The wheat powder was obtained from the Nuclear Agriculture and Biotechnology Division, BARC. The sample was powdered finely and was placed in a cubical box for irradiation by X-ray tube. Rhodium tube was used for irradiation. The spectrum was obtained in 20 seconds.

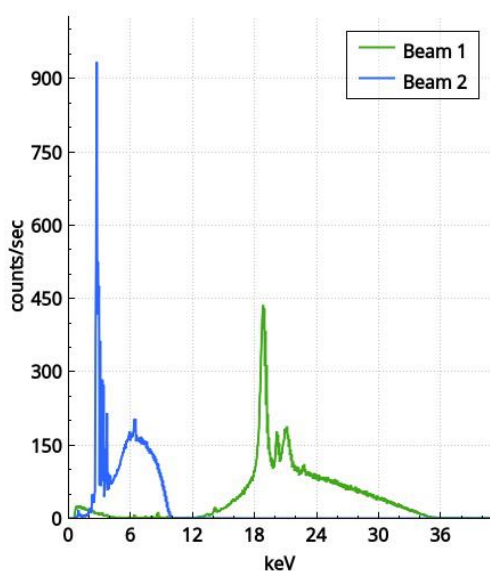
### Figures and Tables

A Typical spectrum of the dental powder is shown in Figure 1. The prominent peaks of K (3.3 keV) and Ca (3.6 KeV) are seen. The beam lines were of (Beam 1 from 12 to 36 keV) and

Beam 2 from 0-12 KeV). The samples are as follows

HD2888	MANNUALY POWDERED
AKAW4210-6	MANNUALY POWDERED
TAW159	MANNUALY POWDERED
TAW33	MANNUALY POWDERED
NIAW1994	POWDERED BY TISSU LYZER
HD2888	POWDERED BY TISSU LYZER
AKAW4210-6	POWDERED BY TISSU LYZER
TAW159	POWDERED BY TISSU LYZER
TAW33	POWDERED BY TISSU LYZER
NIAW1994	WHOLE WHEAT GRAIN
HD2888	WHOLE WHEAT GRAIN
AKAW4210-6	WHOLE WHEAT GRAIN
TAW159	WHOLE WHEAT GRAIN
TAW33	WHOLE WHEAT GRAIN

Al	Si	K	Ca	Fe	Zn	Rb	Sr	Mn
1640	780	2244	796	102	59	4	11	56
1210	730	3202	1004	83	67	4	6	84
1500	670	3807	1222	89	47	6	17	77
1850	920	3382	977	61	37	4	17	52
1680	820	2278	852	74	30	2	11	77
1640	860	1425	1009	81	61	5	13	53
1770	830	2517	967	91	69	4	7	41
1570	860	2277	1239	86	42	7	9	72
1940	1030	2565	798	54	37	6	8	58
1550	880	1202	992	58	36	4	8	71
---	1210	8850	1347	120	76	7	4	86
1730	850	3550	1485	97	79	6	6	80
1600	1050	5750	2186	117	49	9	4	87
1250	950	3035	1440	78	40	8	6	73
1280	800	5290	1479	91	33	5	6	80



which has been documented. Ca is essential in bone building. It is observed that toxic elements such as Pb, Hg are not present.

### Conclusion

Al, Si, K, Ca, Fe and Zn are seen to be present significantly which are useful elements. There are no toxic elements which may harm the human consumption. The role of each of these elements needs to be investigated and the study is underway for further conclusions. Al, S and P which cannot be detected by many conventional instruments in XRF due to the detector window absorbing low energy X-rays could be detected by HHXRF. HHXRF has SDD (Silicon drift detector) which has a graphene window and the Al, P, S X-rays do not get absorbed unlike in the Si (Li) (Lithium drifted Silicon X-ray detector which has Be window and absorbs low energy X-rays below Z<19. HHXRF can be a useful tool for detecting Al in samples

### References

- 1) Front. Plant Sci., 21 February 2014 | <https://doi.org/10.3389/fpls.2014.00053>
- 2) Environmental Science and Pollution Research <https://doi.org/10.1007/s11356-021-13615-0>



### Results and Conclusion

The analysis shows that K is the major element followed by Al, Ca, Si and other minor elements like Fe, Zn, Mn, Rb and Mo. It is observed that Si is present significantly. Silicon the second most abundant element in the earth's crust, is not found free in nature, and occurs as oxides and silicates. It is present in the stroma of mammals probably giving them rigidity and strength. Silicon is found to be useful in the development of bone in two species of experimental animals