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The levels of Trace Metals Contaminants in Wheat Grains, Flours and Breads in Iraq

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Abstract: The trace metals (Mn, Mg, Fe, Cu, Zn, Pb, and Cd), proteins and ash composition of 600 samples of wheat grains, flours and breads were collected from silos, mills and bakeries .Average values of each metals and standard deviation were determined. Milling process reduced the levels of Fe, Cu, Pb considerably. Statistical analysis showed a significant variation in the level of Fe in white flour collected from different mills. Baking increased the levels of Fe, Cu, Pb and Zn significantly in the breads.However, Pb levels was the only elements showed a significant variation among different bakeries.

Key words: Trace metals,milling,flour,bread making process.

INTRODUCTION

The awareness about the safety of food is increasing in several parts of the world (Schroeder, 1974). Many chemical compounds such as pasticides, heavy metals and aflatoxin consider as a toxic contaminate when they occur in a certain levels in foods (Prier *et al* 1980).

Heavy metals are probably the most harmful and insidious contaminants, due to their biological nonbio-degrable nature and their potential to cause adverse effects at certain level of exposure and absorption (Demirozu *et al*., 2002). The harmful effects of trace metals are linked to accumulation in biological system even in their lowest form of development. The health aspects of trace metals have been reviewed extensively by several workers (Sherlock *et al*., 1983., Hu, 2002., Khalil *et al*., 1984). The presence of trace metals in food depend on many factors, such as environmental condition, method of production and processing (Reilly *et al* 1980). Cereal is considered an ideal example of the types of food which effected by some or all these factors mentioned. It has been reported that variation in whole grain contains of trace metals such as Fe, Mn, Mg, Cu, and Zn may be due to environmental condition such as whether during the caltevation,raining and levels of contamination (Dikeman *et al*.,1980; Demirozu *et al*., 2002). Application of chemical fertilizer and using sewage sludge during the cultivation of cereals will substantially increase the levels of Pb, Zn, and Cd (Peterson *et al* 1986; Klaus *et al*., 1987). It has been reported that processing of cereals such as milling, baking and bread making process have a considerable effects on the levels of some of trace metals mentioned (Klaus *et al* 1987.,Wolnik *et al*., 1985). Food processing equipments and containers have long recognized as a source of trace metals such as Fe, Cu, Pb and Cr in the processed foods (Onianwa *et al* 2001). This investigation try to study the effects of milling, baking and various types of bread making in Iraq on the levels of Fe, Cr, Zn, and Mn.

MATERIALS AND METHODS

600 samples of various types of wheats, flours and breads obtained from a number silos, mills and bread making bakers in Baghdad district. These samples were analyzed for trace metals Mn, Mg, Fe, Cu, Zn, Pb and Cd using atomic absorption spectroscopy.1-2 g of samples were wet-ashed with nitric,perichloric acid according to method explained by (Reilly *et al*., 1980; Gholam, 2005). Protein and ash levels were determined using methods described by (Hoseney 1994).

Statistical analysis: Data were statistically treated by F-test with critical probability of o.o5 and P o.o1.

RESULTS AND DISCUSSION

The average values of trace metals, protein and ash for the different types of wheat's (imported and local varieties) are presented in table (1). A wide variation in the concentration of each elements such as Mn, Mg, Fe, and Zn were observed in the wheat's samples examined. This variation is due to a number of factors such as growth condition, environmental factors and weather condition (Peterson *et al*, 1986). However, The average values of trace metals ,protein and ash are similar to that reported by others (Peterson 1983., Khalil., 1984, Gholam *et al*., 2005) .

Statistical differences (F-test) were found among the trace metals concentration of the different varieties of wheat's (table2). The differences were highly significant for trace metals such as Mn, Zn, differences could be

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due several factors like weather, location and extensive uses of fertilizers (Klaus *et al*., 1987., Peterson *et al*, 1983) Mn levels highly effected by the amount of rainfall (Klaus *et al* 1987.,Wolink *et al* .,1985). However, the environmental contamination and excessive uses of sewage sludge during the growth of the plants will have a significant effects on the levels of Pb (Wolnik *et al*., 1985).

Table 1: The concentration of trace metals in ppm (Range +/- Standards deviation) in different types of wheat.

Types of wheat	Mn	Mg	Fe	Cu	Zn	Pb	Cd	Protein %	Ash %
Canadian hard wheat	42.669 +/- 5.671	556.775 +/-91.74	41.355 +/-18.97	0.223 +/-0.129	12.05 +/-14.31	0.581 +/0.200	0.061 +/-0.043	11.624 +/-0.106	1.305 +/-0.224
Australian Hard Wheat	44.676 +/-6.328	562.55 +/-29.922	53.210 +/-35.614	0.396 +/-0.356	15.953 +/-6.46	0.542 +/-0.153	0.09 +/-0.04	11.114 +/-0.847	2.94 +/-0.445
American Soft Wheat	33.025 +/-5.577	600.31 +/-33.06	42.95 +/-41.87	0.363 +/-0.511	14.189 +/-2.327	0.748 +/-0.247	0.07 +/-0.042	10.895 +/-1.399	1.204 +/-0.334
Iraqi Soft Wheat (sabri beak)	31.049 +/-6.814	595.08 +/-68.63	39.748 +/-12.48	0.638 +/-0.515	19.496 +/-8.688	0.27 +/-0.128	0.052 +/-0.04	11.857 +/-0.897	1.386 +/-0.105
Iraqi Hard wheat	34.875 +/-1.998	505.25 +/-24.6	56.323 +/-9.213	0.347 +/-0.278	26.097 +/-4.713	0.311 +/-0.187	0.029 +/-0.037	11.933 +/-0.625	3.15 +/-0.44

Table 2: Statistical analysis (F-test) of variations in tested metals concentration in the different type of wheat.

Metal	F-test
Mn	9.1618**
Mg	3.1150**
Fe	2.8458*
Cu	1.4314 N.S
Zn	11.3086**
Pb	9.2608**
Cd	2.3534 N.S

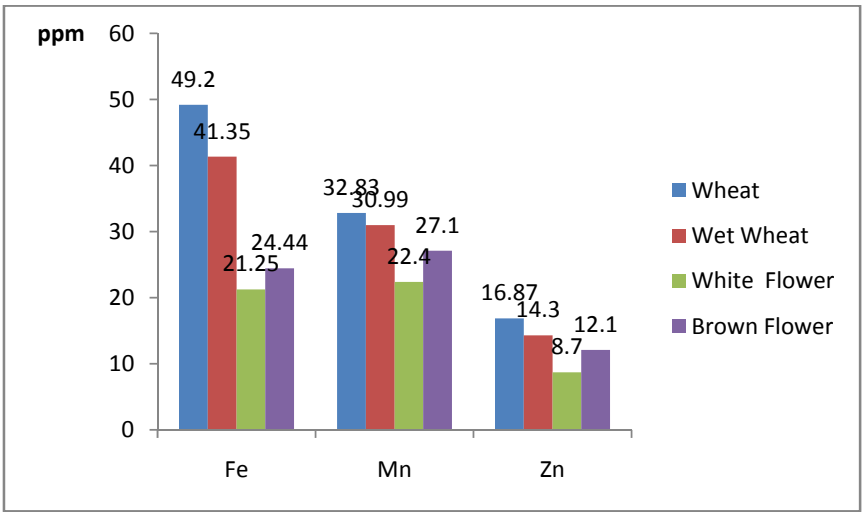
*: Significant at 0.05 probability level.
**: Highly significant at 0.01 probability level.
N.S: Not significant

Et al., 1 shows the effects of different stages of milling process on the levels of Fe, Mn, Zn, Cu, Pb and Cd. It is obvious that milling process reduced the levels of the trace metals mentioned above considerably. Although such reduction are depending on the stages and type of flours produced. Wet wheat (first stage of milling) reduced the level of Fe, Cu, and Cd. This is not surprising ,since the first stages of milling include cleaning and removing the dust, weed seed, stones and then washing with water (Khalil *et al*و 1984). White flour contains less amount (*et al*.1) of Fe, Cu. and Zn than the brown flour. This is mainly due to the facts that the white flour contains mainly endosperm while brown flour contains variable levels of germ beside the endosperm (Kent *et al*., 1970., Zhang *et al*., 1998). It has been reported (Klaus.,1987) that brand and germ contain higher levels of Fe,and Zn.Also the bioavailability of Fe in flours are highly effected by the milling process (Ghplam *et al*., 2005). It is normal practice in Iraq to mill mixed of hard,smi-hard and soft wheat for the bread making flour. Such practices make it difficult to determine the effect of milling process on the different types of wheat mentioned in table (1).

Statistical analysis revealed that no significant differences were observed between the milling factories on the levels of trace metals in brown flour. However, Fe levels shows a very significant difference (F-5.557) between these factories in the white flours. Such variation apparently due to the efficiency of the milling factories to separate the endosperm from bran and germ.

*Et al*ure (2) illustrated the effects of baking process on the level of elements in the three main bread making bakeries in Baghdad district .Apparently Mn and Zn increased considerably in all types of breads. Sources of these trace metals are probably water, salt and other additives which usually added to the bread during the processing ( ). The increase in the levels of Fe, Cu and Pb could be due to equipments and utilities used in these bakeries. It has been reported that food processing equipment and containers have recognized as a source of Fe, Cu and Pb in food (Gholam *et al*., 2005). The levels of the trace metals mentioned found in these types of bread were within the level reported (Zhang *et al*., 1998., Demirozu *et al*., 2002).

F-test indicated no significant differences in the level of trace metals among bread samples obtained from these three bakeries, only Pb level shows a significant differences(F-test 4.483). Field investigation indicated that one of these bakeries (*et al*.2-A) was quite old and located in an industrialized area.



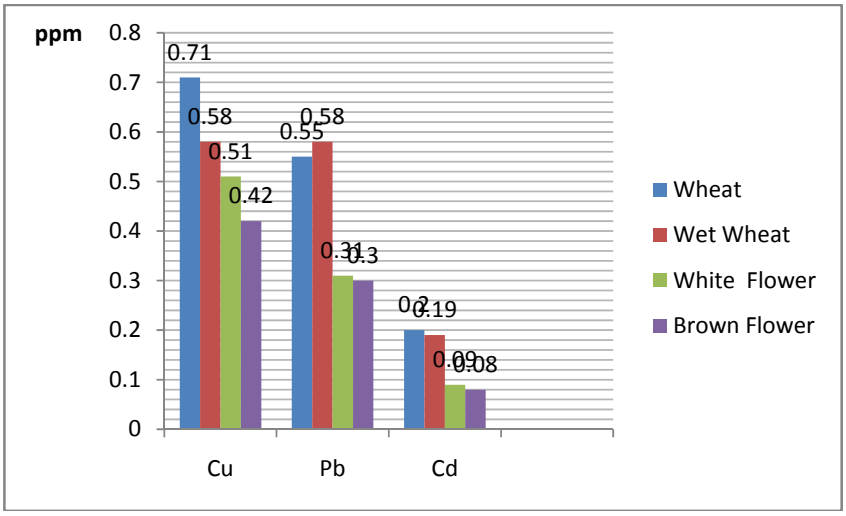
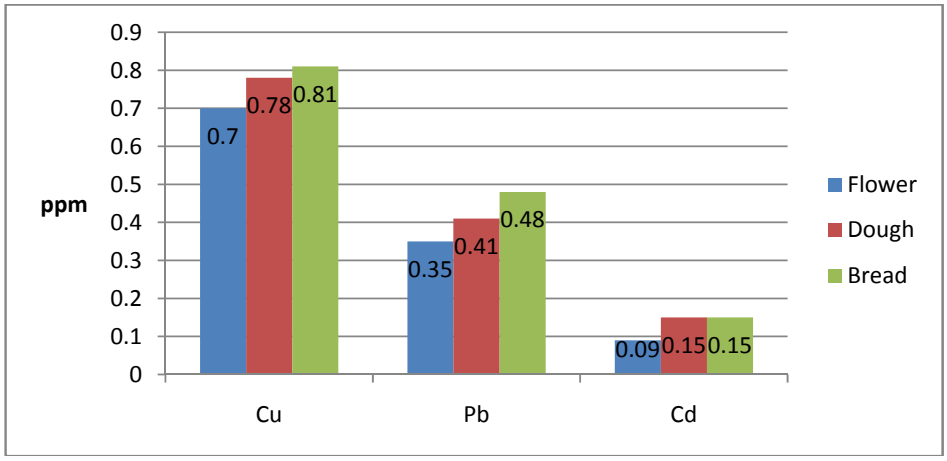
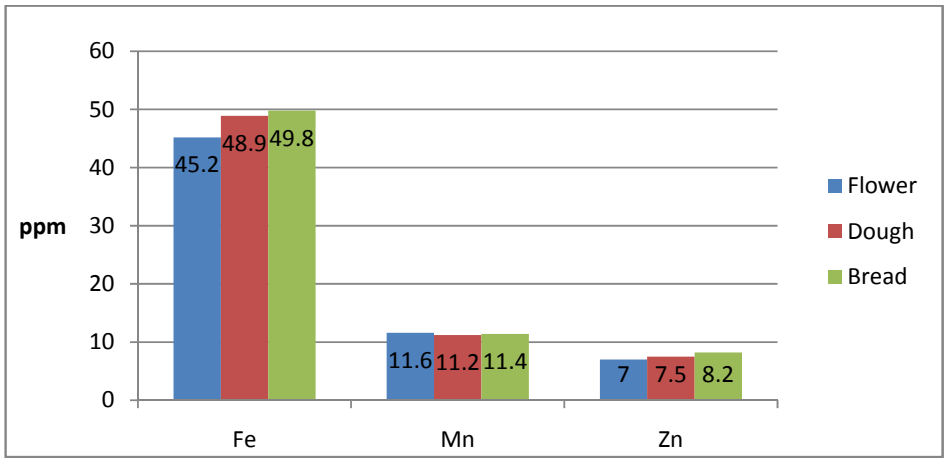
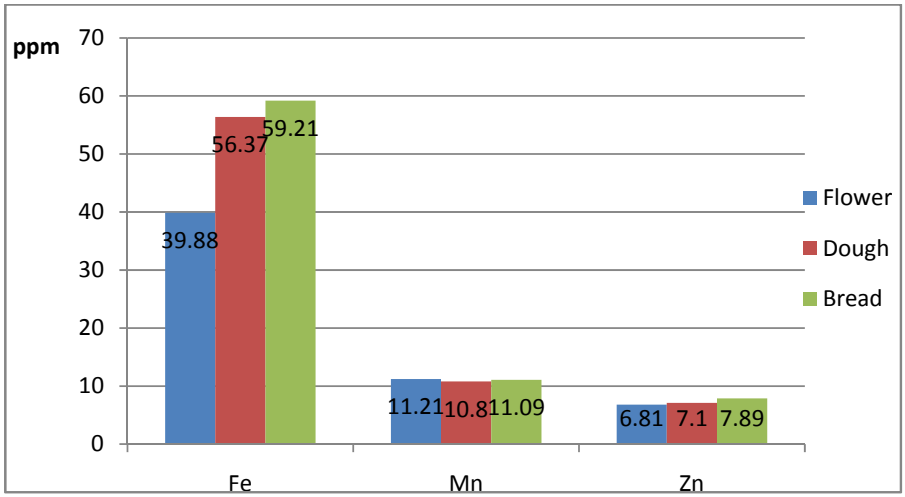


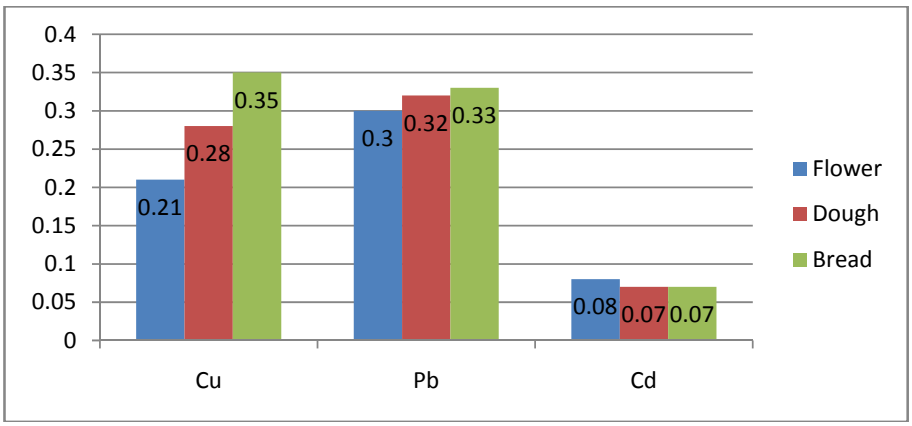
Fig. 1: Effect of Milling on the level of Trace metals.





Bakery A





Bakery B

Fig. 2: The effect of baking on the Level of trace metals (Baker A and B).

Conclusion:

From the present investigation it can be concluded that both milling and baking have a significant effects on the levels of trace metals. Milling process reduced the levels of the trace metals considerably depending on the type and stages of processing. An obvious increase in the levels of Fe, Cu, Mn and to less extend Zn and Pb were found in bread making process. Therefore strict inspection should be carried out on these and other bakeries.

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