Comparative evaluation of some commercially available brands of pharmaceutical preparations for Na, K and Mg concentrations

Sikander Hayat[1], Muhammad Ismail Chughtai[2*], Tariq Mahmood Ansari[1] and Ghulam Mustafa Kamal[2]

[1]Department of Chemistry, Bahauddin Zakariya University, Multan, Pakistan
[2]Nuclear Institute for Agriculture and Biology, P. O. Box 128, Faisalabad, Pakistan

Abstract: A study was carried out to investigate the concentrations of macro-elements (Na^+, K^+ and Mg^{+2}) in twelve commercially available pharmaceutical preparations used as sex stimulant, by Atomic Absorption Spectrophotometer. A wet digestion method was adopted to prepare the samples. The results indicated that sodium concentration was maximum (3702±29 µg g^{-1}) in LB and minimum (495±06 µg g^{-1}) in H-E-H. Potassium concentration was maximum (6337±13 µg g^{-1}) in NBA while minimum (150±06 µg g^{-1}) in ZGRA. Magnesium concentration was maximum in V-100 (9226±11 µg g^{-1}) and minimum in FGRA (1194±25 µg g^{-1}). The concentration of macro-elements in the imported herbal preparations was in the order of Mg>Na>K and in the local herbal preparations as follows: Mg>K>Na. Some of these herbal preparations contain high level of macro-elements than the recommended daily dietary allowances. The excessive use of such preparations may cause severe allergic reactions, kidney damage and pulmonary atherosclerosis.

Keywords: Atomic absorption; macro-elements; herbal preparations; dietary allowances.

INTRODUCTION

Herbalism has long been used traditionally besides conventional medication and playing a key role in advancement of clinical research by maintaining good quality and improved analytical methods. So, the importance of herbal medicines in disease control has increased. In 2008, World Health Organization has estimated about 80% of people throughout the world relying on herbal medicines for primary health care. The market of herbal medicines is growing steadily with annual business of US $ 60 billion (Muazu and Kaita, 2008).

Some important herbs used for sexual stimulation in all over the world are Catuaba, Cayenne, Cuscuta, Damiana, Ginseng, Hawthorn, Epidemium, Maca, Peppermint, Johimbe and Muira. The working principles of the chemical components or ingredients found in these herbs are of following several kinds at different places in the human body:

- improve the body's blood circulation which improves the working of genital organs on sexual stimulation
- stimulate tissue growth and regeneration of sex organs
- stimulate central nervous system to increase psychological arousal which engorge the sexual organs strongly and produce more sexual secretions
- stimulate the feeling bodies in the genital organs which improves their working efficiency
- stimulate the production of sexual hormones to normalize a disturbed hormonal system (Modi *et al.*, 2007).

The use of herbal preparations is increasing with the passage of time. Most of the people use them for different conditions like therapeutic use, primary and secondary prevention and physical enhancement and also for recreational purposes. The basic drawback regarding these peoples is that they educate themselves independently by searching the internet and reading self-help books. This is also fact that such patients do not inform their physicians about the use of herbal medications; therefore, their physicians can not diagnose the problem correctly (Hasan *et al.*, 2009).

The chemical constituents in medicinal plants usually explain the rational for the use of the plants in traditional medicine. The trend now is that phytochemists exploit medicinal plants and isolate bioactive compounds from which different analogues are synthesized with better actions or even different biological properties. Plant's active constituents thus serve as templates for future drug developments (Aliyu and Chedi, 2010).

There are few side effects with the use of herbs than conventional medications. But the major problem is that these herbal medicines are unregulated and mislabeled as they do not give any information regarding additives and contaminants which may cause allergic reactions and some times interact with conventional drugs. It is also reported that the herbal medicines which are imported from Asian countries, normally contain high levels of heavy metals, including lead, mercury, and cadmium. The herbal medicines should be purchased from reputable

**Corresponding author:* e-mail: nishat_dgk@yahoo.com

manufacturers who ensure the quality of product (Gratus *et al.*, 2009).

Currently, there is no organization or agency to certify the labeling of herbal preparations. It means that one is not sure about the amount of the herb contained in the bottle, recommended dose and expiry date. Some herbal preparations are standardized as they contain a specific amount of the active ingredients. However, it is still important to ask companies about their products guarantee (Izzo and Ernst, 2009).

Sex-stimulating pharmaceutical preparations are being used extensively all over the world including Pakistan. A variety of such preparations of different brands are available in the local market. These preparations contain Na, K and Mg as major constituents. Until now a comparative study of these elements has not yet been reported so, a need exists to investigate the concentration of macro-elements (Na, K and Mg) in commercially available imported and local pharmaceutical preparations used for sex stimulation in Pakistan.

MATERIAL AND METHODS

The present study was aimed to assess the concentration of essential macro-elements in herbal preparations used as sex stimulant in Pakistan. For this purpose, following twelve samples of commercially available imported (1-6) and local (7-12) herbal preparations were collected from local market:

Sr. No.	Product code	Brand
1	K-100	Imported
2	FGRA	Imported
3	V-100	Imported
4	LB	Imported
5	PGRA	Imported
6	ZGRA	Imported
7	HEAM	Local
8	NBA	Local
9	H-E-N	Local
10	H-E-M	Local
11	H-E-H	Local
12	HULM-93	Local

The sample solutions were prepared by the method as described by Elving *et al.* (1981). Powdered sample (0.1 g) of each was taken in 50 ml round bottom flask and added 5 ml nitric acid and 3 ml hydrogen peroxide. The solution was refluxed for 30 minutes. After adding 10 ml deionized water, sample solution was filtered and made up volume to 25 ml. These samples were stored in plastic bottles and analyzed for sodium (Na), potassium (K) and magnesium (Mg) by Atomic Absorption Spectro-photometer (A-1800 Hitachi, Japan).

The instrumental conditions used for various metals are given as:

Conditions	Elements		
	Na^+	K^+	Mg^{+2}
Measurement mode	Emission	Emission	Absorbance
Wave length (nm)	589	767	285
Slit width (nm)	0.4	2.6	2.6
Lamp current (mA)	10	10	7.5
Oxidant (air) pressure (kg cm^{-2})	1.6	1.6	1.6
Fuel (C_2H_2) pressure (kg cm^{-2})	0.25	0.30	0.20
Atomizer height (mm)	5.7	7.5	7.5

The data were subjected to analysis of variance to find out statistically significant relationship among herbal preparations by using MSTATC program (version 2.10).

RESULTS

Results indicated that the overall range of sodium concentration in imported herbal preparations was 853 to 3702 µg g^{-1} and in local herbal preparations was 495 to 1619 µg g^{-1}. The maximum sodium conc. (3702±29 µg g^{-1}) was observed in LB and minimum (495±06 µg g^{-1}) in H-E-H (table 1). Analysis of variance showed that there was a highly significant (p<0.05) difference in sodium concentration among all herbal preparations and groups. The interaction between mean concentration of sodium and groups (A×G) was also found highly significant at p<0.05 with co-efficient of variance 1.25% (table 2).

Table 1: Concentration of macro-elements in imported (1-6) and local (7-12) pharmaceutical preparations.

Product code	Mean concentration* (µg g^{-1} of dried weight)		
	**Na^+	**K^+	**Mg^{+2}
K-100	$1141±21^{f}$	$183±12^{hi}$	$1414±28^{f}$
FGRA	$2453±30^{b}$	$167±08^{ij}$	$1194±25^{e}$
V-100	$853±18^{h}$	$200±09^{h}$	$9226±11^{i}$
LB	$3702±29^{a}$	$258±22^{g}$	$3229±15^{k}$
PGRA	$1022±11^{g}$	$183±03^{hi}$	$1261±07^{k}$
ZGRA	$2455±16^{b}$	$150±06^{j}$	$1211±08^{j}$
HEAM	$1227±10^{e}$	$1557±28^{e}$	$6262±11^{e}$
NBA	$1535±23^{d}$	$6337±13^{a}$	$8173±09^{h}$
H-E-N	$1619±08^{c}$	$1487±12^{f}$	$4334±17^{g}$
H-E-M	$585±03^{j}$	$1630±19^{d}$	$3478±05^{d}$
H-E-H	$495±06^{k}$	$1927±07^{c}$	$3133±05^{c}$
HULM-93	$732±17^{i}$	$3760±14^{b}$	$5696±19^{a}$

* Values are mean ± SD of three samples from each preparation analyzed individually in triplicate

** Means in a column with different superscript letters differ significantly at p<0.05

The range of potassium concentration in imported herbal preparations was 150 to 258 µg g^{-1} and in local preparations was 1487 to 6337 µg g^{-1}. The maximum K concentration (6337±13 µg g^{-1}) was observed in NBA and minimum (150±06 µg g^{-1}) in ZGRA (table 1). Analysis of variance showed that there was a highly significant (p<0.05) difference in K concentration among almost all herbal preparations and manufacturer groups (imported and local). The interaction between mean concentration of K and groups (B × G) was also found highly significant at p<0.05 with co-efficient of variance 0.98% (table 2).

The overall range of magnesium concentration in imported herbal preparations was 1194 to 9226 µg g^{-1} and in local herbal preparations was 3133 to 8173 µg g^{-1}. The maximum Mg concentration (9226±11 µg g^{-1}) was observed in V-100 and minimum (1194±25 µg g^{-1}) in FGRA (table 1). Analysis of variance showed that there was a highly significant (p<0.05) difference in magnesium concentration among almost all herbal preparations and manufacturer groups (imported and local). The interaction between mean concentration of magnesium and groups (C × G) was also found highly significant at p<0.05 with co-efficient of variance 0.39% (table 2).

Table 2: Analysis of variance for macro-elements in pharmaceutical preparations.

SOV	DF	SS	MS	F-Value	Probability
A (Na^+)	5	8304313	1660862	4833**	0.0000
G (Groups)	1	7388430	7388430	21502**	0.0000
A × G	5	14202461	2840492	8266**	0.0000
Error	24	8246	343		
				Co-efficient of variance: 1.25%	
B (K^+)	5	27660425	5532085	26084**	0.0000
G (Groups)	1	60512841	60512841	285325**	0.0000
B × G	5	28846140	5769228	27202**	0.0000
Error	24	5090	212		
				Co-efficient of variance: 0.98%	
C (Mg^{+2})	5	73029518	14605903	57091**	0.0000
G (Groups)	1	45907400	45907400	179442**	0.0000
C × G	5	133972418	26794483	104734**	0.0000
Error	24	6140	255		
				Co-efficient of variance: 0.39%	

**highly significant at p<0.01

DISCUSSION

Sodium is a mineral element and an important part of body. It controls the volume of fluid in the body and maintains the acid-base level. Its normal concentration in the blood plasma is 136-145 mM. The condition of low sodium is called hyponatremia and high sodium called hypernatremia. The symptoms of hypernatremia include confusion, coma, paralysis of the lung muscle and death. The severity of the symptoms is related to high sodium level developed. If the level builds up suddenly, the brain cells can't adapt to their new high-sodium environment (Moczydlowski, 2009). In industrialized populations the average sodium intake is approximately 3000-4500 mg/day that is 2-3 folds high in comparison with the current Dietary Reference Intake (DRI) of 1500 mg. The high intake of sodium concentration and sodium to potassium ratio in the diet may increase the chances of arterial hypertension (Karppanen *et al.,* 2005).

Another important electrolyte is potassium which helps in smooth functioning of body, its daily intake below the standard recommended level can lead to a variety of negative consequences for both physical and mental health such as muscle damage, lung failure, poor reflexes, fatigue, insomnia and depression (Otten *et al.,* 2006). The membrane potential is normally maintained by potassium concentration which controls the nerve impulse transmission, contraction of muscle fibers and functioning of the heart. Sometimes, potassium concentration is increased due to kidney disease and drugs reaction which ultimately causes the excretion of potassium in urine and deficiency of hormones (Youn and McDonough, 2008). The Institute of Medicine (IOM) of the National Academies of Science and its Food and Nutrition Board recommended an "Adequate Intake" of potassium as 120 meq/day for adult men and women, ages 19 to >70 years. There are no upper limit restrictions of potassium intake which could reach 200-300 meq/day (Otten *et al.,* 2006).

Magnesium is macronutrient that is required for proper growth, formation and function of our bones and muscles. Magnesium prevents some heart disorders, depression and high blood pressure. Higher intake of magnesium improves lungs function and normal functioning of brain. Sometimes it is injected into patients' veins in emergency situations such as an acute heart or asthma attacks. Regulation of magnesium metabolism against an overload is very efficient; compensating hypermagnesemia represents an effective passive regulatory mechanism (Durlach, 1988).

U.S. National Academy of Sciences has recommended magnesium intake in adults as follows: 300-350 mg/day in males and 300 mg/day in females. In West Germany, the recommended daily allowance for adults is 360 mg magnesium per day (Holtmeier and Kuhn, 1972). Seelig (1986) has recommended that the daily intake of magnesium should be 6 mg/kg. The metabolism, functions and effects of magnesium, calcium, sodium and potassium are closely interconnected in many ways (Dyckner and Wester, 1978). Sullivan (2002) has recommended the daily intakes of minerals as sodium 2400 mg/day, potassium 3500 mg/day (more than 3500 mg causes stomach upset, intestinal problems and heart rhythm disorder) and magnesium 350 mg/day (more than 400 mg may cause stomach problems and diarrhoea).

The newly recommended Dietary Reference Intakes (DRIs) are replaced with the recommendations set in 1989. The DRI for sodium was 1500 mg per day, while 2500 mg has been given as the maximum level of daily intake that causes no adverse effects. In westernized communities, the average sodium intake of 3000–4500 mg per day exceeds clearly from the highest sodium intake level, which has been estimated to be safe. Similarly, the recommended intake of potassium for adolescents and adults is 4700 mg per day, for children of 1–3 years is 3000 mg per day, 4–8 years is 3800 mg per day, and for 9–13 years is 4500 mg per day while the current average potassium intake is 37% of the recommended level in USA which is very low but safe. The recommended magnesium intake is 420 mg per day in adults (Karppanen *et al.*, 2005).

CONCLUSION

Based on results, the order of concentration of macro-elements in the imported herbal preparations was Mg>Na>K and in the local herbal preparations Mg>K>Na. It is also evident that some of these herbal preparations contain high level of macro-elements than the recommended daily dietary allowances. The excessive use of such preparations may cause severe allergic reactions, kidney damage and pulmonary atherosclerosis. The present study provides baseline data on metal concentration in herbal preparations which may be helpful in further research.

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