



Quantitative determination of lead in trade herbal mixtures available in Syrian market

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ABSTRACT

The aim of this study was to evaluate the presence of toxic lead in Syrian herbal mixtures specialized for internal use. Sixty three of dry medicinal mixtures were collected both from herbalist and pharmacies in the Syrian market; the samples were subjects to an acid digestion method followed by Graphite Furnace Atomic Absorption Spectrophotometer analysis in order to specify the concentration for Lead. The result of study indicated that the content of Lead was above the USP 2010, the EC2009 and the WHO2007 permissible limits in 63.5%, 11.11% and 3.17% respectively of the tested samples. Also, the unlicensed samples were higher in lead levels than the licensed ones. This study concludes that there is a major safety concern for the population and it is due to the content of lead in herbal mixtures available in the market so it must be checked for its safe consumption.

Key words: medicinal plants, herbal mixtures, heavy metals, atomic absorption spectrophotometer, acid digestion

INTRODUCTION

Herbal medicines are currently used by large sections of the population. Because they are not regulated as medicines and are freely available to everyone [1], serious safety concerns might be associated with contaminated herbal mixtures especially with the excessive use so they may lead to health risk due to the presence of contaminants like toxic metals [2].

There are two types of herbal mixtures licensed and unlicensed: most medicinal products are unlicensed, their efficacy, safety and quality are still undetermined [3]. However, the licensed ones may contaminate during growing and processing stages [4].

Heavy metals are one of the main sources of pollution in the environment [5], they are natural components of the Earth's crust that cannot be degraded or destroyed and could enter human body via food, drinking water, soft drinks, hot drinks, cigarettes and air^[6].

Lead is nonessential metals and toxic even in very low concentration for human health, it can bind with and dysfunction proteins or enzymes containing sulfhydryl, amine, phosphate and carboxyl groups and cause oxidative stress leading to hematotoxicity, neurotoxicity, nephrotoxicity and reproductive toxicity [7,8].

Aim of study

The objective of this study was to quantify lead in herbal mixtures commonly used in Syria and make a statistic study in order to know whether there are differences between the licensed and unlicensed mixtures in lead levels.

EXPERIMENTAL SECTION**Sample collection and processing**

Sixty three samples of finished herbal mixtures were obtained from local market of Damascus in January 2015 (Table 1). The samples were stored in the plastic food grade containers kept at room temperature until analysis. The samples were dried at 70°C for 48 h in a hot air oven and ground prior to chemical analysis.

Table (1): List of herbal mixtures

Active medicinal plants	Therapeutic use	Sample number
<i>Tilla cordota, Olea europaea, Lippa citriodora, Orthosiphon stamineus.</i>	Anti blood pressure mixture	(1)
<i>Matricaria chamomilla, Althaea officinalis, Origanum majorana, Thymus vulgaris, Nigella sativa, Glycyrrhiza glabra, Plantago lanceolata, Pimpinella Anisum.</i>	Expectorant mixture	(2)
<i>Thymus vulgaris, Mentha piperita, Lippa citriodora. Matricaria chamomilla.</i>	Common cold mixture	(3)
<i>Ginkgo biloba, Pollen, Salvia officinalis, Cinnamomum zeylanicum.</i>	Memory Tonic mixture	(4)
<i>Matricaria chamomilla, Pimpinella Anisum, Lippa citriodora, Cinnamomum zeylanicum.</i>	Colon disorders mixture	(5)
<i>Mentha piperita, Ammi visnaga, Zea mays, Equisetum arvense, Nigella sativa, Thymus vulgaris, Althaea officinalis.</i>	Renal colic mixture	(6)
<i>Cassia angustifolia, Pimpinella Anisum, Matricaria chamomilla, Tilla cordota, Lippa citriodora.</i>	Laxative mixture	(7)
<i>Carum Carvi, Pimpinella Anisum, Origanum majorana, Matricaria chamomilla, Mentha piperita, Cuminum cyminum.</i>	Carminative mixture	(8)
<i>Cassia angustifolia, Salvia officinalis, Pimpinella Anisum, Althaea officinalis, Hyssopus officinalis.</i>	Slimming mixture	(9)
<i>Pimpinella Anisum, Carum Carvi, Cuminum cyminum, Trigonella foenum, Lippa citriodora, Cinnamomum zeylanicum.</i>	Lactation mixtures	(10)
<i>Thymus vulgaris, Nigella sativa, Ammi visnaga, Eucalyptus lobules, Mentha piperita. Matricaria chamomilla.</i>	Anti bronchus inflammation mixture	(11)
<i>Cinnamomum aromaticum, Camellia sinensis, Zingiber officinale, Elettaria cardamomum</i>	Tonic mixture	(12)
<i>Urtica dioica, Curcubita pepo, populous species, Cinnamomum aromaticum.</i>	Anti Prostate swelling mixture	(13)
<i>Thymus vulgaris, Mentha piperita, Lippa citriodora.</i>	Cold mixture	(14)
<i>Salvia triloba, Avena sativa, Mentha piperitae, Ocimum basilicum.</i>	Anti diabetic mixture	(15)
<i>Pine pollen, Cinnamomum zeylanicum, Mentha piperita.</i>	Appetizer and fattened mixture	(16)
<i>Cassia angustifolia, Pimpinella Anisum, Salvia officinalis.</i>	Slimming mixture	(17)
<i>Syzygium aromaticum, Cuminum cyminum, Linum usitatissimum, Coriandrum sativum.</i>	Analgesic mixture	(18)
<i>Cassia angustifolia, Rheum palmatum, Pimpinella Anisum, Mentha piperita.</i>	Laxative mixture	(19)
<i>Matricaria chamomilla, Foeniculum vulgare, Lippa citriodora, Thymus Vulgaris, Pimpinella Anisum, Carum Carvi.</i>	Anti spasmodic for babies	(20)
<i>Matricaria chamomilla.</i>	Anti spasmodic for babies	(21)
<i>Pimpinella Anisum.</i>	Calm baby mixture	(22)
<i>Valeriana officinalis, Matricaria chamomilla, Lippa citriodora, Pimpinella Anisum.</i>	Nervous system calm mixture	(23)
<i>Thymus vulgaris, Rosa gallica, Papaver rhoeas, Althea officinalis.</i>	Cough mixture	(24)
<i>Thymus vulgaris, Eucalyptus globulus, Salix alba, Saponaria officinalis, Althea officinalis.</i>	Expectorant mixture	(25)
<i>Cassia angustifolia, Salvia officinalis, Pimpinella Anisum.</i>	Laxative mixture	(26)
<i>Cassia angustifolia, Pimpinella Anisum, Salvia officinalis, Althaea officinalis, Agropyrum repens.</i>	Slimming mixture	(27)
<i>Trigonella foenum-graecum, Nigella sativa, Gum Arabica, Ocimum basilicum.</i>	Anti diabetes mixture	(28)
<i>Silybum marianum, Cynara cardunculus, Peumus boldus.</i>	Liver mixture	(29)
<i>Cinnamomum zeylanicum, Panax ginseng, Pine pollen.</i>	Tonic mixture	(30)
<i>Matricaria chamomilla, Foeniculum vulgar, Lippa citriodora.</i>	Calm baby mixture	(31)
<i>Glycyrrhiza glabra, Althaea Officinalis, Thymus vulgaris, Matricaria chamomilla.</i>	Cough mixture	(32)
<i>Cynara scolymus, Curcuma Xanthorrhizia, Harpagophytum procumbens.</i>	Liver mixture	(33)
<i>Rheum ribes, Trigonella foenum-graecum, Cuminum cyminum.</i>	Anti diabetes mixture	(34)
<i>Camellia sinensis, Rheum Palantum, Cuminum cyminum.</i>	Slimming mixture	(35)
<i>Cuminum cyminum, Foeniculum Vulgare, Matricaria chamomilla.</i>	Carminative mixture	(36)
<i>Ammi visnaga, Carum carvi, Nigella sativa, Thymus vulgaris.</i>	Anti spasmodic mixture	(37)
<i>Rheum ribes, Salvia triloba, Althea officinalis, Pimpinella Anisum.</i>	Anti diabetes mixture	(38)
<i>Cassia angustifolia, Carum Carvi, Matricaria chamomilla.</i>	Slimming mixture	(39)
<i>Ocimum basilicum, Thymus vulgaris, Matricaria chamomilla.</i>	Common cold mixture	(40)
<i>Hypericum perforatum, Veronica Officinalis, Lavandula officinalis, Pimpinella Anisum.</i>	Nervous system calm mixture	(41)
<i>Valeriana officinalis Linum usitatissimum, Pimpinella Anisum.</i>	Cardiac calm mixture	(42)
<i>Rosmarinus officinalis, Fumaria officinalis, Curcuma xanthorrhizia.</i>	Liver mixture	(43)
<i>Matricaria chamomilla, Pimpinella Anisum</i>	Anti spasmodic for babies	(44)
<i>Rosemarinus officinalis, Pimpinella Anisum</i>	Anti spasmodic for babies	(45)
<i>Matricaria chamomilla, Cuminum cyminum</i>	Baby carminative mixture	(46)
<i>Pimpinella Anisum, Foeniculum vulgar.</i>	Calm baby mixture	(47)
<i>Cassia angustifolia, Camellia sinensis, Avena sativa, Rosmarinus officinalis.</i>	Slimming mixture	(48)
<i>Carum carvi, Ricinus Communis, Croton tiglium.</i>	Laxative mixture	(49)
<i>Curcuma xanthorrhizia, Cynara scolymus, Cuminum cyminum.</i>	Liver mixture	(50)
<i>Croton tiglium, Peumus boldus, Althaea officinalis. Rosmarinus officinalis.</i>	Liver mixture	(51)
<i>Trigonella foenum-graecum, Lupinus albus, Salvia triloba, Mentha piperita, Ocimum basilicum.</i>	Anti diabetes mixture	(52)
<i>Allium sativum, Apocynum cannabinum, Tilla cordota, Silybum marianum.</i>	Anti blood pressure mixture	(53)

<i>Matricaria chamomilla, Carum carvi, Cuminum cyminum.</i>	Anti spasmodic for babies	(54)
<i>Matricaria chamomilla, Anethum graveolens.</i>	Anti spasmodic for babies	(55)
<i>Trigonella foenum-graecum, Nigella sativa, Gum Arabica, Ocimum basilicum.</i>	Anti diabetes mixture	(56)
<i>Rheum ribes, Trigonella foenum-graecum, Cuminum cyminum.</i>	Anti diabetes mixture	(57)
<i>Silybum marianum, Cynara cardunculus, Peumus boldus.</i>	Liver mixture	(58)
<i>Curcuma xanthorrhiza, Cynara scolymus, Rosmarinus officinalis, Cuminum cyminum.</i>	Liver mixture	(59)
<i>Cassia angustifolia, Pimpinella Anisum, Salvia officinalis.</i>	Slimming mixture	(60)
<i>Cassia angustifolia, Pimpinella Anisum, Matricaria chamomilla, Tilia cordata, Lippa citriodora.</i>	Laxative mixture	(61)
<i>Cassia angustifolia, Salvia officinalis, Pimpinella Anisum</i>	Laxative mixture	(62)
<i>Carum carvi, Ricinus Communis, Cassia angustifolia.</i>	Laxative mixture	(63)

Analysis

Lead analysis was done according to method 3050b [9]. For this, 5.0 g powder of each sample was digested in HNO₃(65%) and H₂O₂(30%) (2:1) using the wet digestion method by heating slowly on a hot plate in the fume hood chamber until a clear solution was obtained. The final volume of the solution was made up to 50 ml with deionized water. All necessary precautions were adopted to avoid possible contamination of the samples. Analysis was done using the Graphite Furnace Atomic Absorption Spectrophotometer (Varian GTA 100). The standard reference material of the lead (E. Merck) was used for calibration and quality assurance for each analytical batch. The efficiency of digestion of plant samples was determined by adding standard reference material of metals to different samples. After addition of standards, samples were digested, and metals were estimated as described above. Three replicates were analyzed to assess precision of the analytical techniques, and results were averaged.

RESULTS AND DISCUSSION

The concentration of Pb in studied samples are mentioned and shown in Table (2). The highest concentration of lead was detected in unlicensed slimming mixture while the lowest concentrations were detected in both unlicensed appetizer and anti-cold mixtures.

Table (2) Lead concentration in the tested herbal mixtures

Sample number	Concentration (ppm)	Sample number	Concentration (ppm)
(1)	1.3	(33)	2.5
(2)	0.7	(34)	0.5
(3)	0.3	(35)	3.2
(4)	2.3	(36)	1.8
(5)	0.4	(37)	4.9
(6)	0.3	(38)	1.9
(7)	0.5	(39)	10.2
(8)	0.6	(40)	1.1
(9)	1.1	(41)	0.8
(10)	1.1	(42)	1.9
(11)	1.5	(43)	5.9
(12)	0.6	(44)	1.7
(13)	2.4	(45)	2.2
(14)	0	(46)	1.5
(15)	0.9	(47)	1.2
(16)	0	(48)	1.4
(17)	10.6	(49)	1.2
(18)	1.5	(50)	0.5
(19)	2.6	(51)	1.9
(20)	1	(52)	0.5
(21)	1.1	(53)	2.3
(22)	0.6	(54)	1.3
(23)	0.9	(55)	1.1
(24)	2	(56)	1.5
(25)	3.1	(57)	1.8
(26)	0.9	(58)	0.7
(27)	0.5	(59)	1.3
(28)	1.8	(60)	3.6
(29)	0.4	(61)	0.5
(30)	1.1	(62)	1
(31)	1.6	(63)	1.3
(32)	1.7		

The next table shows the permissible limits of Lead according to WHO 2007, the EC 2019 and the USP 2010 for herbal preparations. Table (3).

Table (3) List of Limit References for lead in medicinal herbal preparation

Limit Reference For Pb (ppm)	WHO 2007	EC 2009	USP 2010
	10	3	1

According to the next figure 3.17% (2 of 63) and 11.11% (7 of 63) of the tested mixtures have Lead concentrations above the WHO2007 and the EC2009 permissible limit which is 10ppm and 3ppm respectively, while a major of 63.5% (40 of 63) of the tested mixtures have Lead concentrations above the USP 2010 permissible limit which is 1ppm with a p-value=0.004 (less than 0.05) for T-student test. So we can conclude that the total herbal mixtures exceeded significantly the highest USP2010 permissible limit of lead.

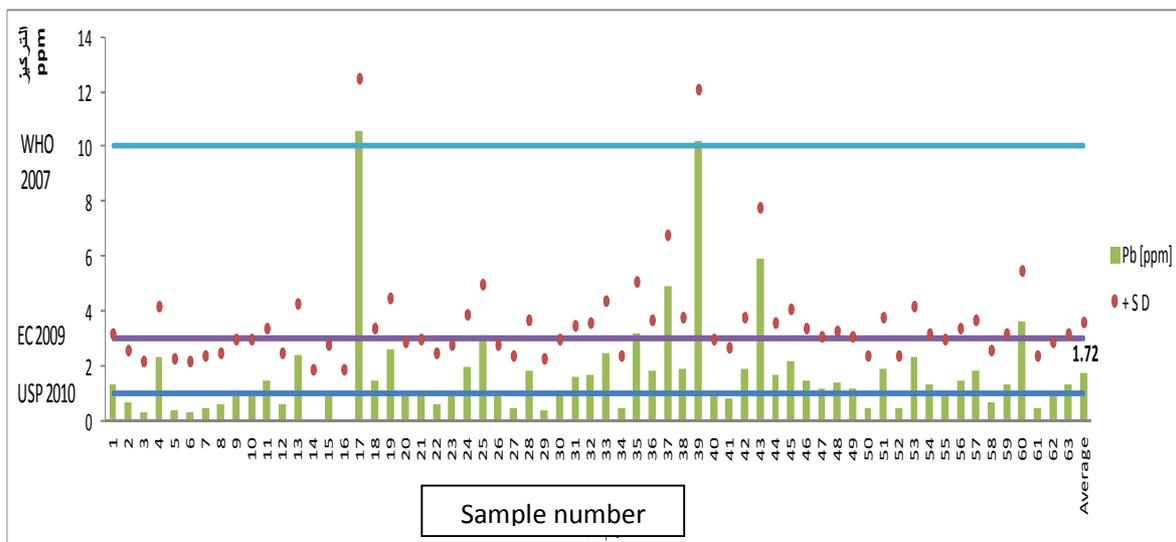


Fig (1): Lead concentrations in tested herbal mixtures

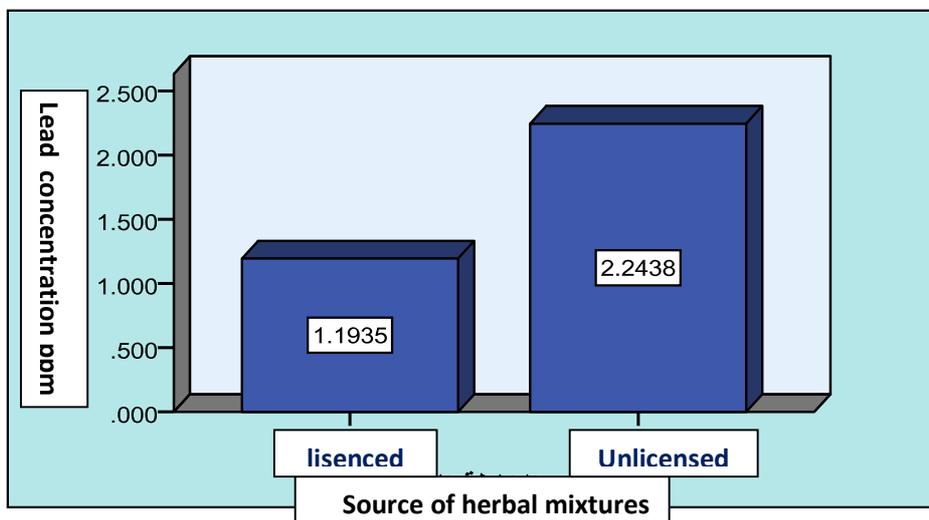


Fig (2): Lead concentrations according to the source of herbal mixtures

The presence of lead may be due to contamination of air and soil. These medicinal plants may grow in polluted soils, irrigate with contaminated water or contaminate by automotive Pb emissions to atmosphere, by sewage sludge, by smelter emissions, by pesticides, and by metal-enriched manure in addition to manufacturing processes and the bad storage condition like the use of lead containers.

For making a comparison between both sources of herbal mixture, a student T-test was applied to know whether there are significant differences between the licensed and the unlicensed mixtures in lead levels. The p-value was 0.027 which is less than 0.05 so we can conclude that the unlicensed mixtures contain significantly higher levels of lead than the licensed mixtures as shown in fig (2).

CONCLUSION

- The highest amount of lead was detected in unlicensed slimming mixture.
- The average of lead in tested herbal mixtures exceeded significantly only the USP2010 permissible limits, while it was within both the EC2009 and the WHO 2007 permissible limits.
- The unlicensed mixtures contain significantly higher levels of lead than the licensed mixtures.

Acknowledgments

The objective of this study was to quantify lead in medicinal herbal mixtures available without prescription in the Syrian market. The results suggest that herbal mixtures used for specific therapeutic indications may be a source of toxic lead consumption, so it should be checked for heavy metals limits (specially lead) in order to avoid their toxic effects to the consumers and benefit only from their therapeutic use.

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