

Exposures and Intoxications after herb-induced poisoning: A retrospective hospital-based study

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Abstract:

Many people believe that the plants are inherently safe and a useful tool for human health, because they are not considered "real drugs". An increasing number of cases of poisoning has been registered dating back from the mid-90s up to now. In order to highlight the entity of plant exposures and to develop appropriate poisoning prevention and information, a retrospective analysis of the plant poisoning over a 12 year period (1995 – 2007) has been carried out. The Poison Control Center of Milan records over a thousand cases of plant poisoning per year. One third of the cases involves children up to the age of 4 and the exposures originate mainly from accidental ingestion of houseplants or toxic plants around the house. In 15% of the cases adults were not able to give a description of the plant or to specify or describe the ingested part. More serious cases occur in adults who either erroneously confused a plant as edible or deliberately ingested a toxic plant. The incidence of plant poisoning depends on local customs, traditional recipes, nutritional factors, *etc.* It is important to identify the plants by their latin name, as common names vary from region to region and often the same common name is used to identify different plants.

Keywords: Plant poisoning, retrospective study, toxic plants, Poison Control Center

Introduction:

The ingestion or exposure to potentially poisonous plants presents a serious worry at hospital poisoning centre. A twelve-year report (1995-2007) regarding the adverse events due to wild or houseplants consumption is here presented. The Milan Poison Center, founded in 1967, is open both to the general public and health specialists, 24 hours a day, 365 days a year, and it is the most frequently consulted Italian Poison Centre nationwide: 65 % cases of all Italian intoxication cases are monitored by the Milan Poison Center [1].

During 2007, *e.g.*, the Milan Poison Center assisted 59,846 callers, thanks to its emergency phone lines. Just about one third of the cases were children up to the age 4 years old, but the most serious cases occurred in adolescents and adults; more than 65 % of the calls were placed from private houses; 966 people phoned in because their pets or other animals were exposed to a poison, and pet species ranging from dogs (the most common) to cats, birds, horses, cows and fishes. There

are about 10,000 ca. calls for poison-related informations.

In a plant poisoning cases, a close cooperation between the Poison Center and non-physician consultant (*e.g.*) botanists is essential in order to confirm the medical diagnosis and to help in the prevention and management of the deleterious effects of toxic plants on human health. More effective information concerning the most common plant exposures should be given to the general public to create greater awareness regarding safe plants and also to instruct health specialists.

In this study a report of injurious plant exposures is presented and the data are displayed in tabular and graphical form. Some examples of acute and severe toxicity due to wild plants used as food in traditional recipes and social behaviour are discussed.

Materials and Methods:

This retrospective study is exclusively based on the examination of anonymous medical files concerning expositions and/or intoxications registered by the

Milan Poison Center Niguarda Hospital between 1995 and 2007. An admission database is updated electronically at the Poison Center of all patients who contact the hospital. All the phone calls received by clinical toxicologist physicians were classified, according to an operating procedure, on the basis of the agent, clinical presentation, affected age group, origin of the phone call, and time from exposure to the toxic agent, they were then prospectively recorded in a clinical database. The input of the patient and poisoning data is as simple as possible to minimize the time spent to record the data. Only in a few cases, it was possible to have a correct specimen of the entire plant, including the root. Usually the sample for the identification was a plant fragment either fresh, cooked, dried, frozen, conserved in olive oil or a fragment obtained from the gastric content.

In this retrospective study, all the calls registered were revised by the botanists in order to evaluate the number of exposures for each plant, and the origin of the plant in order to distinguish between “native” and “introduced” plants [8]. “Native” plant is a plant grown naturally, developed or migrated to the site without human help or intervention. On the contrary, the “introduced” plant is brought to site intentionally or accidentally with human help or activity. The definition given for the word “native” in Webster’s Dictionary is “growing, living, or produced originally in a certain place”.

The adopted classification system for flowering plants, Angiosperms, was according to the reclassification published by the “Angiosperm Phylogeny Group II” (9). For Gymnosperms and Ferns the adopted classification system was in compliance with Kramer *et al.* (10).

Results:

To assess the extent of plant poisoning registered by the Milan Poison Center, a survey from 1995 to 2007 was carried out. It showed that the cases per year vary from 800 to 1404 (Fig. 1). The total recorded

number of 12,363 cases included 1,846 exposures in which the patients were not able to refer to the physician the name of the ingested plant or had no any residue of the ingested toxic plant (Fig. 2). In about 10,000 cases the plant responsible for each exposure was identified and the plants were grouped into 338 botanical entities: genus, species, subspecies, cultivar (Table I). Then it is important to understand which plant the intoxicated people has thought they had picked and then eaten. In Table II are reported the more relevant poisonous plants that have edible look-alikes and their incriminated substances are included. Botanical details referring the exact identification of toxic plant species are intentionally omitted in order to avoid potentially dangerous errors in the identification.

Young shoots collected in spring as “wild asparagus”.

Young shoots, such as “wild asparagus”, are picked, but this common name is related to different plant genus and species, not necessarily only to the *Asparagus* genus. In the period, between 1995-2007, 31 patients presented clinical features of aconite poisoning following the ingestion of young shoots and leaves, of what they supposed “wild asparagus”. The aconite poisoning was related to diterpenoid esters alkaloids, aconitine, mesaconitine, hypaconitine as main compounds; the best known compound, aconitine, is exceedingly toxic. The clinical picture was characterized by neurological, gastrointestinal and cardiac symptoms. Within 10 – 30 min from aconite ingestion, patients developed a tingling, burning sensation in their tongue, lips and whole mouth, gradually extending to their arms and entire body, accompanied by a feeling of cold and feeling very sick. Nausea, vomiting and diarrhoea were present and various cardiac abnormalities and severe dysrhythmias were reported.

The most severe intoxications were recorded in Northern Italy in 2005, when unfortunately young aconite shoots were

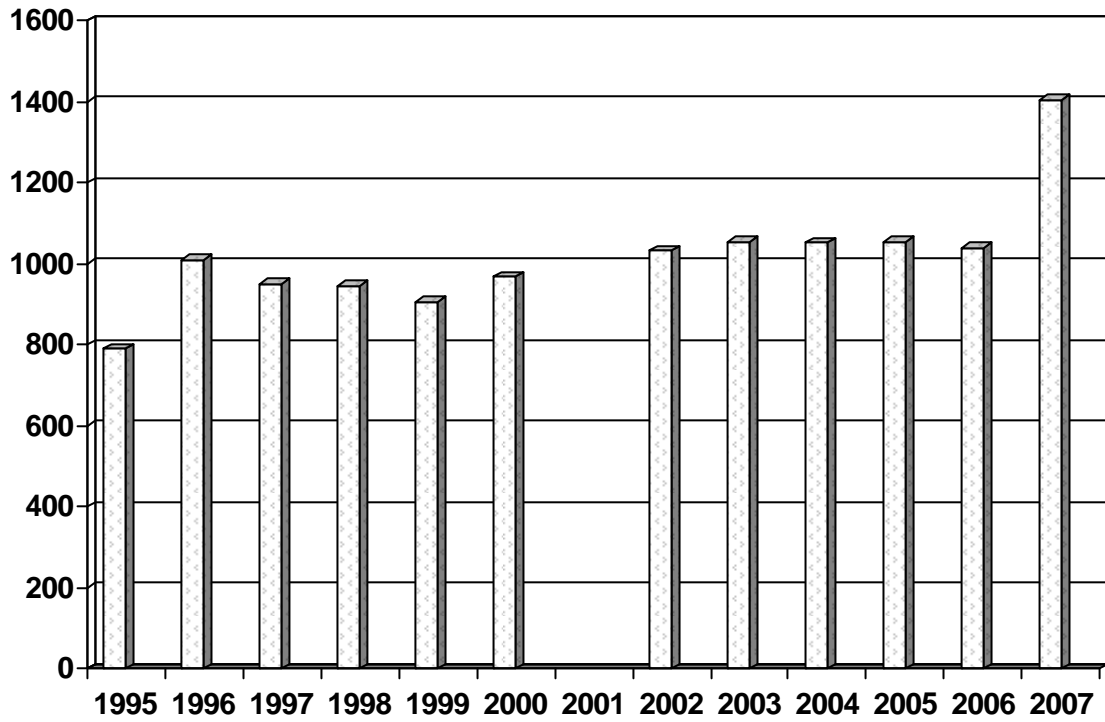


Figure 1: Total plant exposures from 1995 to 2007, distributed per year

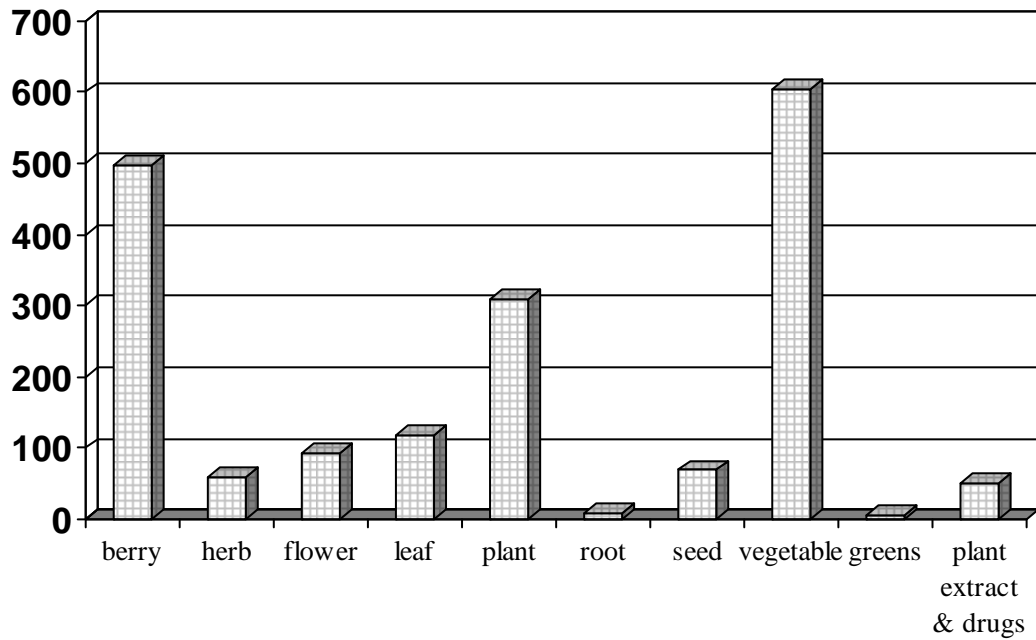


Figure 2: Plant exposures tentatively related to unknown vegetable part

Table I: List of the identified wild (native = n) and house plants (introduced = i), related to plant exposures monitored in the period 1995-2007

Scientific name	vernacular name	occurrences	family	origin*
<i>Abies</i> spp. s .l.	Firs	9	Pinaceae	n/i
<i>Acacia</i> s.l. spp.	Acacia	80	Fabaceae	i
<i>Acacia dealbat</i>	Acacia	11	Fabaceae	i
<i>Acer</i> spp.	Maple	11	Aceraceae	n/i
<i>Aconitum</i> spp.	Monkshood	31	Ranunculaceae	n
<i>Actaea spicata</i>	Baneberry	1	Ranunculaceae	n
<i>Aeonium sedifolium</i>		1	Crassulaceae	i
<i>Aeschynanthus</i> sp.		1	Gesneriaceae	i
<i>Aesculus hippocastanum</i>	Horse chestnut	96	Hippocastanaceae	i
<i>Aethusa cynapium</i> or <i>Conium maculatum</i>	Poison hemlock	21	Apiaceae	n
<i>Agave</i> spp.	False aloe	31	Agavaceae	i
<i>Albizia julibrissin</i>	Flatcrown	7	Fabaceae	i
Algae		1		n/i
<i>Allium</i> spp.	Garlic	9	Alliaceae	n/i
<i>Allium cepa</i>	Onion	3	Alliaceae	i
<i>Alocasia</i> spp.	Alocasia	55	Araceae	i
<i>Aloë</i> spp.	Aloe	26	Asphodelaceae	i
<i>Alyssum</i> sp.	Pale madwort	1	Brassicaceae	n
<i>Amaryllis</i> spp.	Amaryllis	10	Amaryllidaceae	i
<i>Ambrosia</i> spp.	Ragweed	3	Asteraceae	n
<i>Ampelopsis</i> sp.	Virginian creeper	1	Vitaceae	i
<i>Anagyris foetida</i>		1	Fabaceae	n/i
<i>Ananas</i> sp.	Pineapple	1	Bromeliaceae	i
<i>Anemone</i> s.l. sp.	Anemone	2	Ranunculaceae	n
<i>Anthurium</i> spp.	Flamingo flower	92	Araceae	i
<i>Antirrhinum majus</i>	Snapdragon	1	Scrophulariaceae	n/i
<i>Aralia</i> spp.	Aralia	11	Araliaceae	i
<i>Araucaria</i> spp (<i>A.</i> + <i>Zantedeschia</i> 1)	Brazilian pine	2	Araucariaceae	i
<i>Arbutus unedo</i>	Strawberry tree	7	Ericaceae	n
<i>Ardisia crenata</i>	Coral berry	9	Myrsinaceae	i
<i>Armoracia rusticana</i>	Horseradish	1	Brassicaceae	i
<i>Arnica montana</i>	Mountain arnica	74	Asteraceae	n
<i>Artemisia absinthium</i>	Wormwood	5	Asteraceae	n
<i>Arum italicum</i>	Cuckoo pint	45	Araceae	n
<i>Arum maculatum</i>	European spotted arum	34	Araceae	n
<i>Aspalathus linearis</i>	Rooibos, red tea	2	Fabaceae	n
<i>Asparagus</i> spp.	Asparagus	14	Asparagaceae	n/i
<i>Asparagus officinalis</i>	Asparagus	6	Asparagaceae	n/i
<i>Atropa belladonna</i> (berries 3)	Deadly nightshade	116	Solanaceae	n
<i>Aucuba japonica</i> (berries 21)	Japanese laurel	50	Garryaceae	i

<i>Azalea</i> sp.				
Bamboo	Bamboo	5	Poaceae	i
<i>Begonia</i> spp.	Begonias	55	Begoniaceae	i
<i>Berberis</i> spp.	Barberry	2	Berberidaceae	n/i
<i>Betula pendula</i>	Birch	2	Betulaceae	n
<i>Borago officinalis</i>	Borage	2	Boraginaceae	n/i
<i>Bougainvillea</i> spp.	Buganvillea	9	Nyctaginaceae	i
<i>Brassica oleracea</i>	Cabbages	1	Brassicaceae	i
<i>Bromus</i> sp.	Cheat grass	1	Poaceae	n
<i>Bryonia</i> sp.	Red bryony	1	Cucurbitaceae	n
<i>Buxus sempervirens</i>	Box	6	Buxaceae	i
Cactus	Cactus	94	Cactaceae	i
<i>Caesalpinia japonica</i>		2	Fabaceae	i
<i>Caladium</i> sp.	Alocasia, Angel wings	1	Araceae	i
<i>Calathea</i> sp.	Allouya	2	Marantaceae	i
<i>Calendula</i> spp.	Marigold	21	Asteraceae	n/i
<i>Callicarpa</i> sp.	Beauty berries	1	Verbenaceae	i
<i>Camellia</i> spp.	Common camellia	5	Theaceae	i
<i>Camellia sinensis</i>	Tea	1	Theaceae	i
<i>Campanula carpatica</i>	Tussock bellflower	1	Campanulaceae	i
<i>Campsis radicans</i>	Trumpet creeper	8	Bignoniaceae	i
<i>Cannabis sativa</i> (incl. <i>C. indica</i>)	Hashish	2	Cannabaceae	i
<i>Capsicum annum</i>	Pepper	91	Solanaceae	i
<i>Carpinus betulus</i>	European hornbeam	1	Betulaceae	n
<i>Carpobrotus</i> sp.	Hottentot's fig	1	Aizoaceae	i
<i>Carya illinoensis</i>	Hickory, Pecan	1	Juglandaceae	i
<i>Cassia</i> spp.	Senna	4	Fabaceae	i
<i>Castanea sativa</i>	Chestnut	2	Fagaceae	n/i
<i>Cedrus atlantica</i>	Atlas cedar	1	Pinaceae	i
<i>Cercis siliquastrum</i>	Juda's tree	1	Fabaceae	n/i
<i>Chamaerops humilis</i>	Dwarf palm	1	Arecaceae	n/i
<i>Chelidonium majus</i>	Greater celandine	3	Papaveraceae	n
<i>Chimonanthus praecox</i>	Wintersweet	2	Calycanthaceae	i
<i>Chlorophytum comosum</i>	Spider plant	1	Anthericaceae	i
<i>Chrysanthemum</i> spp.	Chrysanthemum	6	Asteraceae	n/i
<i>Cichorium intybus</i>	Chicory	2	Asteraceae	n/i
<i>Cinnamomum camphora</i>	Camphor tree	3	Lauraceae	i
<i>Citrus aurantium</i> (fruit)	Bitter orange	1	Rutaceae	i
<i>Citrus aurantium</i> var. <i>bergamia</i>	Bergamot	1	Rutaceae	i
<i>Clematis</i> spp.	Traveller's Joy	3	Ranunculaceae	n/i
<i>Clivia</i> spp.	St. John's lily	6	Amaryllidaceae	i
<i>Cocos nucifera</i>	Coconut	2	Arecaceae	i
<i>Codiaeum variegatum</i>	Croton	4	Euphorbiaceae	i
<i>Codonanthe</i> sp.		1	Gesneriaceae	i
<i>Coffea arabica</i>	Coffee	3	Rubiaceae	i
<i>Colchicum</i> spp.	Meadow saffron	11	Colchicaceae	n
<i>Colocasia antiquorum</i>	Elephant's ear	19	Araceae	i

<i>Columnea</i> sp.	Wound wort	1	Gesneriaceae	i
<i>Commelina communis</i>	Day flower	6	Commelinaceae	i
<i>Conium maculatum</i>	Poison hemlock	2	Apiaceae	n
<i>Consolida ajacis</i>	Rocket larskspur	2	Ranunculaceae	n
<i>Convallaria majalis</i>	Lily of the valley	29	Convallariaceae	n
<i>Cornus</i> spp.	Dogwood	3	Cornaceae	n/i
<i>Cormus domestica</i> (<i>Sorbus domestica</i>)	Service tree	1	Rosaceae	n/i
<i>Cosmos bipinnatus</i>		1	Asteraceae	i
<i>Cotoneaster</i> spp.	Rose-box	107	Rosaceae	i
<i>Cotoneaster salicifolius</i>	Willowleaf cotoneaster	78	Rosaceae	i
<i>Crassula</i> spp.	Jade plant	5	Crassulaceae	i
<i>Crassula ovata</i>		18	Crassulaceae	i
<i>Crataegus</i> spp.	Hawthorn	24	Rosaceae	n
<i>Crocus sativus</i>	True saffron	21	Iridaceae	i
<i>Crocus</i> spp.	Dutch crocus	2	Iridaceae	n/i
<i>Crotolaria</i> sp.	Rattlepods	1	Fabaceae	i
<i>Cucurbita maxima</i> (5 seeds)	Pumpkin	10	Cucurbitaceae	i
<i>Cucurbita pepo</i>	Zucchini	1	Cucurbitaceae	i
<i>Cupressus</i> s.l.	Cypress	5	Cupressaceae	i
<i>Curcuma alismatifolia</i>	Turmeric	1	Zingiberaceae	i
<i>Cycas revoluta</i>	Crozier cycas	3	Cycadaceae	i
<i>Cyclamen</i> spp.	Cyclamen	86	Primulaceae	n/i
<i>Cymbopogon nardus</i>	Citronella grass	1	Poaceae	i
<i>Cyperus involucratus</i>	Papyrus	4	Cyperaceae	i
<i>Dahlia</i> spp.	Dahlia	2	Asteraceae	i
<i>Daphne</i> spp.		8	Thymelaeaceae	n
<i>Daphne mezereum</i>	Mezereon	6	Thymelaeaceae	n
<i>Datura</i> s.l. spp.	Datura	102	Solanaceae	n/i
<i>Dendrobium</i> sp.	Orchid	1	Orchidaceae	i
<i>Dianella</i> sp.	Flax lily	1	Hemerocallidaceae	i
<i>Dianthus</i> spp.	Pink carnation	4	Caryophyllaceae	i
<i>Dieffenbachia</i> spp.	Dumb cane	382	Araceae	i
<i>Digitalis</i> spp.	Foxglove	2	Plantaginaceae	n/i
<i>Digitalis purpurea</i>	Foxglove	4	Plantaginaceae	n/i
<i>Dioscorea</i> sp.	Yam	1	Dioscoreaceae	i
<i>Dioscorea communis</i> (<i>Tamus communis</i>)	Black briony	2	Dioscoreaceae	n
<i>Diospyros kaki</i>	Chinese persimmon, Kaki	1	Ebenaceae	i
<i>Dittrichia viscosa</i>	False yellowhead	1	Asteraceae	n/i
<i>Dracaena</i> spp.	Corn plant	113	Dracenaceae	i
<i>Drosera</i> sp.	Sundews	1	Droseraceae	n
<i>Echeveria</i> spp.	Echeveria	5	Crassulaceae	i
<i>Echinacea</i> spp.	Corneflower	2	Asteraceae	i
<i>Elaeagnus</i> spp. (1 berries)	Oleaster	4	Elaeagnaceae	i
<i>Epipremnum pinnatum</i> (<i>Pothos aureus</i>)	Pothos	131	Araceae	i
<i>Episcia cupreata</i>	Flame violet	1	Gesneriaceae	i

<i>Equisetum</i> sp.	Horsetail	1	Equisetaceae	n
<i>Erica</i> spp.	Heather	2	Ericaceae	n/i
<i>Eucalyptus</i> spp.	Eucalyptus	8	Myrtaceae	i
<i>Euonymus</i> spp.	Burning bush	8	Celastraceae	n
<i>Euphorbia pulcherrima</i>	Poinsettia	583	Euphorbiaceae	i
<i>Euphorbia</i> spp.	Spurge	64	Euphorbiaceae	i
<i>Euphorbia lathyris</i>	Caper spurge	2	Euphorbiaceae	i
<i>Euphrasia</i> sp.	Eyebright	1	Scrophulariaceae	n
<i>Fagus sylvatica</i>	European beech	1	Fagaceae	n
Fern	Fern	6		n/i
<i>Ficus benjamina</i>	Weeping fig	446	Moraceae	i
<i>Ficus elastica</i>	Rubber plant	52	Moraceae	i
<i>Ficus pandurata</i>	Fiddle-leaf fig	1	Moraceae	i
<i>Ficus</i> spp.	Ficus	122	Moraceae	i
<i>Fragaria vesca</i>	Wild strawberry	3	Rosaceae	n
<i>Fragaria</i> spp.	Strawberry	10	Rosaceae	n/i
<i>Freesia</i> spp.	Freesia	3	Iridaceae	i
<i>Fuchsia</i> spp. (1 berries)	Fuchsia	13	Onagraceae	i
<i>Galium</i> sp.	Bedstraw	1	Rubiaceae	n
<i>Gardenia</i> sp.	Gardenia	2	Rubiaceae	i
<i>Ginkgo biloba</i>	Maidenhair tree	3	Ginkgoaceae	i
<i>Gladiolus</i> spp.	Gladioli	2	Iridaceae	i
<i>Gossypium</i> spp.	Cotton	4	Malvaceae	i
<i>Guzmania lingulata</i>	Sacrlet star	1	Bromeliaceae	i
<i>Gypsophilla</i> spp.	Baby's breath	1	Caryophyllaceae	i
<i>Hamamelis</i> sp.	Witch-hazel	1	Hamamelidaceae	i
<i>Haworthia albicans</i>	Cobweb aloe	1	Asphodelaceae	i
<i>Hedera</i> spp. (1 berries)	Common ivy	69	Araliaceae	n/i
<i>Helianthus annuus</i>	Sunflower	2	Asteraceae	i
<i>Helleborus</i> spp.	Hellebore	2	Ranunculaceae	n
<i>Helleborus foetidus</i>	Stinking hellebore	1	Ranunculaceae	n
<i>Heracleum</i> spp.	European cow parsnip	1	Apiaceae	n
<i>Hevea brasiliensis</i>	Caoutchouc	1	Euphorbiaceae	i
<i>Hibiscus sinensis</i>	Rose of China	1	Malvaceae	i
<i>Hibiscus</i> spp.	Rose-mallows	6	Malvaceae	i
<i>Howeia</i> spp.	Kentia	7	Arecaceae	i
<i>Humulus lupulus</i>	Hop	1	Cannabaceae	n
<i>Hyacinthus</i> spp.	Hyacinth	28	Hyacinthaceae	i
<i>Hydrangea</i> spp.	Hydrangea	67	Hydrangeaceae	i
<i>Ilex aquifolium</i> (berries 14)	Holly	177	Aquifoliaceae	n/i
<i>Impatiens balsamina</i>	Busy Lizzy	5	Balsaminaceae	i
<i>Iris</i> spp.	Iris	13	Iridaceae	n/i
<i>Jasminum</i> spp.	Jasmine	61	Oleaceae	i
<i>Jatropha</i> sp.	Physic / Purging nut	1	Euphorbiaceae	i
<i>Juglans regia</i>	Common walnut	2	Juglandaceae	i
<i>Juniperus sabina</i>	Savine	1	Cupressaceae	n/i
<i>Juniperus</i> spp.	Juniper	3	Cupressaceae	n/i
<i>Kalanchoe</i> spp.	Kalancoe	7	Crassulaceae	i

<i>Laburnum anagyroides</i>	Golden chain tree	42	Fabaceae	n/i
<i>Lactuca virosa</i>	Wild lettuce	1	Asteraceae	n
<i>Lantana camara</i>	Spanish flag	4	Verbenaceae	i
<i>Lathyrus sativus</i>	Chickling pea	1	Fabaceae	i
<i>Laurus nobilis</i>	Laurel	102	Lauraceae	n/i
<i>Lavandula</i> spp.	Lavender	18	Lamiaceae	i
<i>Leucanthemum vulgare</i>	Dog daisy	1	Asteraceae	n
<i>Ligustrum</i> spp. (1 berries)	Privet	28	Oleaceae	n/i
<i>Lilium</i> spp.	Lily	56	Liliaceae	i
<i>Lindera benzoin</i>	Spice bush	2	Lauraceae	i
<i>Linum usitatissimum</i>	Flax	1	Linaceae	n
<i>Liriodendron tulipifera</i>	Tulip tree	1	Magnoliaceae	i
<i>Litchi chinensis</i>	Litchi	1	Sapindaceae	i
<i>Lonicera</i> spp.	Honeysuckle	18	Caprifoliaceae	n/i
<i>Lupinus</i> spp.	Lupine	4	Fabaceae	n/i
<i>Magnolia grandiflora</i>	Magnolia	3	Magnoliaceae	i
<i>Magnolia</i> spp.	Magnolia	70	Magnoliaceae	i
<i>Mahonia</i> spp.	Barberry	63	Berberidaceae	i
<i>Mandragora autumnalis</i>	Autumn mandrake	50	Solanaceae	n
<i>Manihot esculenta</i>	Cassava	2	Euphorbiaceae	i
<i>Maranta</i> spp.	Arrowroot	1	Marantaceae	i
<i>Matricaria chamomilla</i>	Chamomile	41	Asteraceae	n/i
<i>Medinilla</i> sp.	Medinilla	1	Melastomataceae	i
<i>Melaleuca alternifolia</i>	Tea tree	3	Myrtaceae	i
<i>Mespilus germanica</i>	Medlar	3	Rosaceae	i
<i>Mirabilis jalapa</i>	Four o'clock plant	51	Nyctaginaceae	i
<i>Monstera deliciosa</i>	Mexican-breadfruit	8	Araceae	i
<i>Morus alba</i>	White mulberry	3	Moraceae	n
<i>Musa</i> spp.	Banana	4	Musaceae	i
<i>Muscari</i> sp.	Grape hyacinth	1	Hyacinthaceae	n/i
Musk	Musk	7	Bryophyta	n
<i>Nandina domestica</i>	Heavenly bamboo	75	Berberidaceae	i
<i>Narcissus jonquilla</i>	Jonquil	9	Amaryllidaceae	i
<i>Narcissus</i> spp.	Daffodil	66	Amaryllidaceae	n
<i>Nephrolepis</i> spp.	Ornamental house fern	1	Nephrolepidaceae	i
<i>Nerium oleander</i>	Oleander	572	Apocynaceae	n/i
<i>Nicotiana</i> sp.	Tobacco	1	Solanaceae	i
<i>Ocimum basilicum</i>	Basil	16	Lamiaceae	i
<i>Oenothera biennis</i>	Evening primrose	1	Onagraceae	i
<i>Olea europaea</i>	Olive tree	4	Oleaceae	n/i
<i>Onopordum acanthium</i>	Scotch thistle	1	Asteraceae	n
<i>Operculicarya decaryi</i>	Jabily	2	Anacardiaceae	i
<i>Opuntia</i> spp.	Prickly pears	3	Cactaceae	n/i
Orchid	Orchid	38	Orchidaceae	i
Palmae	Palm	4	Arecaceae	i
<i>Papaver rhoeas</i>	Red poppy	2	Papaveraceae	n
<i>Papaver</i> spp.	Poppy	21	Papaveraceae	n/i
<i>Paris quadrifolia</i>	Herb Paris	1	Mealanthiaceae	n

<i>Parthenocissus quinquefolia</i>		6	Vitaceae	n/i
<i>Parthenocissus</i> spp.	Virginian creeper	72	Vitaceae	n/i
<i>Passiflora</i> sp.	Passion flore	1	Passifloraceae	n/i
<i>Paullinia cupana</i>	Guarana shrub	8	Sapindaceae	i
<i>Pausinystalia yohimbe</i>	Yohimbe	1	Rubiaceae	i
<i>Pelargonium</i> spp.	Storksbill	223	Geraniaceae	i
<i>Petroselinum crispum</i>	Parsely	3	Apiaceae	i
<i>Petunia hybrida</i>	Petunia	11	Solanaceae	i
<i>Phaseolus vulgaris</i>	Common bean	1	Fabaceae	i
<i>Philodendron</i> spp.	Philodendron	76	Araceae	i
<i>Phoenix dactylifera</i>	Date palm tree	2	Arecaceae	i
<i>Photinia</i> spp.	Popular ornamental shrub	3	Rosaceae	i
<i>Physalis alkekengi</i>	Winter cherry	3	Solanaceae	n/i
<i>Phytolacca. americana</i>	Pokeweed	54	Phytolaccaceae	n
<i>Pieris japonica</i>	Japanese andromeda	3	Ericaceae	i
<i>Pistacia lentiscus</i>	Lentisk	3	Anacardiaceae	n
<i>Pisum sativum</i>	Common pea	3	Fabaceae	i
<i>Pittosporum</i> spp.	Pittosporum	17	Pittosporaceae	i
<i>Platycerium bifurcatum</i>	Elks horn fern	2	Polypodiaceae	i
<i>Podophyllum</i> sp.	Mandrake	1	Berberidaceae	i
<i>Polygonum aviculare</i> s.l.	Knotweed	1	Polygonaceae	n
<i>Poinciana-Erythostemon</i> group.	Bird of Paradise	22	Fabaceae	i
<i>Poncirus trifoliata</i>	Trifoliolate orange	1	Rutaceae	i
<i>Populus</i> sp.	Poplar	1	Salicaceae	n/i
<i>Portulaca oleacea</i>	Green purslane	1	Portulacaceae	n
<i>Potentilla indica (Duchesnea i.)</i>	False strawberry	11	Rosaceae	i
<i>Primula</i> spp.	Primrose	14	Primulaceae	n/i
<i>Prunus armeniaca</i>	Apricot	15	Rosaceae	n/i
<i>Prunus avium</i>	Sweet cherry	7	Rosaceae	n/i
<i>Prunus domestica</i>	Plum	1	Rosaceae	n
<i>Prunus dulcis</i> (seeds)	Bitter almond	42	Rosaceae	i
<i>Prunus laurocerasus</i>	Cherry laurel	147	Rosaceae	n/i
<i>Prunus persica</i>	Peach	7	Rosaceae	i
<i>Prunus x pissardii</i>	Purple Cherry Plum	1	Rosaceae	i
<i>Prunus</i> spp.		9	Rosaceae	n
<i>Punica granatum</i>	Pomegranate	2	Lythraceae	i
<i>Pyracantha</i> spp. (1 berries)	Fire thorn	137	Rosaceae	i
<i>Quercus</i> spp. (19 acorn)	Oak	21	Fagaceae	n/i
<i>Radermachera sinica</i>	China Doll, Serpent Tree	1	Bignoniaceae	i
<i>Ranunculus</i> spp.	Buttercups	5	Ranunculaceae	n/i
<i>Raphanus</i> sp.	Radish	1	Brassicaceae	n/i
<i>Rhamnus alaternus</i>	Italian Buckthorn	1	Rhamnaceae	n/i
<i>Rhodiola rosea</i>	Goldenroot, Roseroot	1	Crassulaceae	n/i
<i>Rhododendron</i> spp.	Rosebay, Azalea	112	Ericaceae	n/i
<i>Ribes nigrum</i>	Black currant	10	Grossulariaceae	i
<i>Ribes</i> spp.	Currant	8	Grossulariaceae	i
<i>Ricinus communis</i> (15 seeds)	Castor bean tree	57	Euphorbiaceae	n/i
<i>Robinia pseudoacacia</i>	Black (false) locust tree	4	Fabaceae	n

<i>Rosa</i> spp.	Rose	16	Rosaceae	n/i
<i>Rubus idaeus</i>	Raspberry	1	Rosaceae	n/i
<i>Ruscus aculeatus</i> (4 berries)	Butcher's broom	107	Ruscaceae	n
<i>Ruta graveolens</i>	Rue	4	Rutaceae	n/i
<i>Saintpaulia ionantha</i>	African violet	16	Gesneriaceae	i
<i>Salix</i> sp.	Willow	2	Salicaceae	n/i
<i>Sambucus nigrum</i>	Elderberry	5	Adoxaceae	n
<i>Sambucus</i> spp. (4 berries)	Elder	135	Adoxaceae	n
<i>Sansevieria</i> spp.	Snake plant	120	Dracenaceae	i
<i>Saponaria officinalis</i>	Soapwort	5	Caryophyllaceae	n/i
<i>Schefflera</i> sp.	Schefflera	1	Araliaceae	i
<i>Schinus molle</i>	Californian peppertree	1	Anacardiaceae	i
<i>Schoenocaulon officinale</i> (<i>Sabadilla officinalis</i>)	Sabadilla	1	Melanthiaceae	i
<i>Scilla</i> s.l. spp.	Squill	2	Hyacinthaceae	n/i
<i>Scutellaria</i> spp.	Skullcap	2	Lamiaceae	n/i
<i>Sedum morganianum</i>	Burro's tail, Donkey tail	4	Crassulaceae	i
<i>Senecio serpens</i>	Blue Chalksticks	1	Asteraceae	i
<i>Sesbania</i> spp.	Sesban	5	Fabaceae	i
<i>Silybum marianum</i>	Marian Thistle	1	Asteraceae	n
<i>Skimmia</i> sp.	Skimmia	1	Rutaceae	i
<i>Solanum dulcamara</i>	Bitter Nightshade	7	Solanaceae	n
<i>Solanum nigrum</i>	Black Nightshade	26	Solanaceae	n
<i>Solanum pseudocapsicum</i> (berries 3)	Jerusalem cherry	35	Solanaceae	i
<i>Solanum</i> spp. (berries 8)	Nightshade	99	Solanaceae	n/i
<i>Sophora</i> sp.	Scholar's Tree	1	Fabaceae	i
<i>Sorbus aucuparia</i>	European Rowan	2	Rosaceae	n/i
<i>Spartium junceum</i>	Spanish Broom	68	Fabaceae	n/i
<i>Spathiphyllum</i> spp.	Peace lily	218	Araceae	i
<i>Strychnos nux-vomica</i>	Poison nut	3	Loganiaceae	i
<i>Symphoricarpos albus</i>	Common snowberry	1	Caprifoliaceae	i
<i>Syringa vulgaris</i>	Lilac	2	Oleaceae	i
<i>Tagetes minuta</i>	Wild marigold	5	Asteraceae	i
<i>Tagetes</i> sp.	Marigolds	1	Asteraceae	i
<i>Taraxacum officinale</i> s.l.	Common dandelion	5	Asteraceae	n
<i>Taxus baccata</i> (red berry-like : aril 5)	European yew	150	Taxaceae	n/i
<i>Theobroma cacao</i>	Cacao tree	1	Malvaceae	i
<i>Thevetia peruviana</i>	Lucky nut	3	Apocynaceae	i
<i>Thuja</i> s.l. spp.	Tree of life	6	Cupressaceae	i
<i>Tilia</i> spp.	Linden tree	18	Tiliaceae	n/i
<i>Toxicodendron</i> spp.	Poison ivy	7	Anacardiaceae	i
<i>Trachelospermum jasminoides</i>	Star jasmine	3	Apocynaceae	i
<i>Trifolium</i> spp.	Red / White clover	5	Fabaceae	n/i
<i>Tulipa</i> spp.(2 bulbs)	Tulip	64	Liliaceae	i
<i>Urtica</i> sp.	Nettle	1	Urticaceae	n
<i>Veratrum</i> sp.	White hellebore	1	Melanthiaceae	n

<i>Veronica albicans</i>	Bird's eye	1	Scrophulariaceae	n
<i>Viburnum lantana</i>	Wayfaringtree	6	Adoxaceae	n/i
<i>Viburnum</i> spp.	Guleder rose	5	Adoxaceae	n/i
<i>Vicia faba</i>	Faba bean	6	Fabaceae	i
<i>Viola</i> spp. (2 <i>V. tricolor</i>)	Violets	5	Violaceae	n/i
<i>Viscum album</i> s.l. (8 berries)	Mistletoe	256	Santalaceae	i
<i>Washingtonia filifera</i>	California fan palm	1	Arecaceae	i
<i>Wisteria sinensis</i> (6 seeds)	Chinese wisteria	146	Fabaceae	i
<i>Xanthosoma</i> sp.		1	Araceae	i
<i>Yucca</i> spp.	Spanish bayonet	12	Agavaceae	i
<i>Zamia</i> sp.	Coontie	1	Zamiaceae	i
<i>Zamioculcas zamiifolia</i>	ZZ plant / Aroid palm	33	Araceae	i
<i>Zantedeschia aethiopica</i>	Calla lilly	105	Araceae	i
<i>Ziziphus zizyphus</i> (<i>Z. jujuba</i>)	Jujube	2	Rhamnaceae	i

origin = native (n) or introduced (i)

picked and then eaten as “mountain asparagus”. Initial clinical picture registered in the patients were generalized paresthesia, nausea, diarrhea, vertigo, thoracic pain, dyspnea, and dyschromatopsia. Within one hour, patients presented ventricular tachycardia and fibrillation with different severity : one person died and five had ventricular tachycardia fibrillation in the intensive care unit with renal failure.

Young leaves picked in spring as “bear’s garlic”

Bear’s garlic, *Allium ursinum*, grows wild in Northern Italy and Central Europe. In spring, the leaves are picked to be eaten. Several cases of poisoning have been reported in recent years, since there are some toxic plants with quite similar leaves, particularly the autumn crocus leaves (meadow saffron, naked ladies, *Colchicum autumnale*, Colchicaceae) (11 cases: 2 deadly ones) and the lily-of-the-valley (*Convallaria majalis*) (29 cases).

The autumn crocus is a very poisonous plant : all its parts are rich in colchicine, a highly toxic alkaloid. Ingestion of *Colchicum* leaves, eaten as cooked vegetables, leads to profuse vomiting and diarrhea, which can be bloody, followed by hypovolemic shock and multisystem organ failure within 24-72 hours. Subsequent complications include bone marrow suppression with resultant

leukopenia, thrombocytopenia, and possibly sepsis. Coma, convulsions, and sudden death occur.

The Lily-of-the-valley, *C. majalis*, contains convallarin and related cardioactive glycosides with physiological effects similar to those of the *Digitalis*, but their concentration in the leaves is comparatively low, and, as a consequence, life-threatening conditions due to poisoning seldom occur.

Nerium oleander, oleander or rosebay, exposures

Oleander is one of the most common poisonous plants : it is a tall, evergreen, mediterranean shrub with leathery, linear-lanceolate, long leaves and terminal cymes of tubular flowers. It is often planted as a screen along highways, particularly in the central strip separating the two lanes of traffic. The most significant of these toxins are oleandrin and neriine, cardiac glycosides. They are present in all parts of the plant but mainly in the sap. Oleander has a high level of toxicity and it has been reported that in some cases even a small amount can have lethal or nearly lethal effects. It is thought that a handful or 10-20 leaves consumed in infusion by an adult can cause an adverse reaction, and a single leaf could be lethal to an infant or child. A method of transferring the toxicity from the plant to food is by using the little branches of oleander to prepare skewers

for barbecues. During the monitored period 1995 – 2007, 572 cases of poisoning were registered in Italy. According to the Toxic Exposure Surveillance System (TESS, database containing information on all calls made to most Poison Centers in the U.S.A.) in 2002 there were 847 known human poisonings in the United States related to oleander. Some intoxications were related to birds: they can suffer a reaction or death if the perches inside the cages are made from this plant.

Toxicity of houseplants.

Exposures to houseplants containing oxalate crystals, such as *Philodendron* and *Dieffenbachia*, are among the most common toxic plant exposures [14]. In the past, the irritant properties of the *Dieffenbachia* plant had various uses, including punishing slaves and treating gout, impotence, and frigidity [15, 16]. Nowadays, plants containing oxalate are admired for their ornamental beauty and they can be found in public places or homes. The following plants containing oxalates were responsible for exposures, registered mainly in children: Anthurium (*Anthurium* species 92 cases), Arum (*Arum* species 79 cases), Calla lily (*Zantedeschia* species 105 cases), Dieffenbachia (*Dieffenbachia* species 382 cases), Monstera, Ceriman (*Monstera deliciosa* 8 cases), Philodendron (*Philodendron* species, 76 cases), Pothos or Hunter's robe (*Epipremnum pinnatum*) (131 cases). Non-soluble calcium oxalate crystals are found in plant stems, roots, and leaves. The stalk of the *Dieffenbachia* plant produces the most severe reactions. These needle-like crystals produce pain and oedema when they come in contact with lips, tongue, oral mucosa, conjunctiva, or skin. The oedema is primarily due to direct trauma from the needle-like crystals and, to a lesser extent, by other plant toxins (*e.g.* bradykinins, enzymes) [17]. Poinsettia (*Euphorbia pulcherrima*) exposures accounted for 583 cases and formed the subset that was

analyzed to critically evaluate the morbidity associated with poinsettia exposures. There were no true problems among poinsettia exposures and 98% were accidental, involving mainly children. The majority of exposed patients were not treated in a health care facility and did not develop any toxicity related to their exposure to the poinsettia. Poinsettia plants are houseplants very common in December, when the red-leaved plants are used as Christmas decorations. While the genus *Euphorbia*, to which the poinsettia plant belongs, includes some highly toxic plants like the *Euphorbia lathyris*, the popular poinsettia itself is not considered to be a primary irritant. *E. lathyris* is a tall plant with upright unbranched stems which carry four rows of rigidly arranged leaves and insignificant yellow flowers in mid-summer. The whole plant is highly toxic both when ingested and by contact. Its milky sap contains phorbol and ingenol esters which cause skin and eyes irritation (66 cases) and tumour promotion [18, 19].

Discussion:

At first we have to consider that the toxic plants are very important for scientists : a lot of new toxic plants must be screened in order to develop new medicines. The toxic secondary metabolites have a leading role in drug development. The Plant Kingdom produces many thousands of secondary metabolites, also known as natural products, chemical compounds, that – it seems – are not essential for normal growth, development or reproduction of an organism. In this sense they are considered “secondary”. These chemicals are extremely diverse : terpenes, phenolics, nitrogen-containing compounds, *etc.* Many secondary metabolites are toxic or repellent to herbivores, microbes and humans and help to defend the plants that produce them. If certain secondary metabolites are consumed as food, they can have severe consequences, whilst most pharmaceutical derived from plant chemical structure act

as life-saving drugs, *e.g.* digoxin, taxol, vincristine, morphine, *etc.*

The problem of plant poisoning is not so vast compared to, *e.g.*, intoxication by synthetic drugs, chemicals or pesticides. However, it is the individual severe cases that determine the medical dimension of the problem. As described above, certain vegetable poisonings are associated with high morbidity and exceptional mortality. The average of plant exposures monitored by the Poison Control Center of Milan, Niguarda Ca' Granda Hospital, is about 2% of the total registered calls. Among all plants considered to be toxic, some are really dangerous whereas others only cause minor troubles, mostly in the digestive sphere.

The French Poison Centre in Strasbourg, stated that plants are responsible for 5% of the intoxications listed by Poison Centers [21]. In Germany the average plant intoxications is 9.7% per year [22]. The American Association of Poison Control Centres [AAPCC] Report 2006 states that plant poisoning is 4% of the registered intoxications [23].

In conclusion we can confirm that plant exposures are common and Poison Information Centres devote a significant clinical service and information to manage them and to enhance public awareness. The number of intoxications due to plants has increased both in number and proportion. Plant exposures concerned mainly children who ingested not only colourful berries and fruits, but also leaves and flowers. The more serious poisonings usually involve adults who have either mistaken a plant as edible or have deliberately ingested the plant to obtain supposed medicinal results or toxic properties (suicide).

Some plants have both poisonous and edible parts and others are poisonous if eaten raw but not when cooked. There are other plants which are poisonous for part of the year but are edible during other periods. Always make sure you are certain about what you are going to eat and that it

is edible. Consult a good reference book, the general public must remember that many photographs don't always report the correct botanical features necessary for the identification and often the photos are not good enough to be relied upon in order to identify a wild plant correctly. The established collaboration between botanists and Poison Center physicians is profitable for the recognition of specific plant species and exposure frequency in a region. It could become the base for medical/hospital staff training and the development of appropriate poison prevention information brochures.

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References:

- [1] Mucci N., Alessi M., Binetti R., Magliocchi M.G. *Ann. Ist. Super. Sanità* 2006, 42, 268-276
- [2] Strozzi M., Marolda M., Colombo M.L. *Congress Italian Society Toxicology*, 1996, 151
- [3] Colombo M.L., Moro P.A., Zoppi F., Primavera S., Poti C., Assisi F., Martella A., Zanardini C. *Toxicology Letters* 2003, 144 Suppl. 1, S 67
- [4] Colombo M.L., Perego S., Marangon K., Davanzo F., Assisi F., Moro P.A. *Pagine Botaniche* 2006, 31, 3-51
- [5] Moro P.A., Assisi F., Della Puppa T., Marangon K., Colombo M.L., Menniti Ippolito F. *Drug Safety* 2006, 29, 364
- [6] Mattiolo O., Gallino B., Pallavicini G. *Phytoalimurgia pedemontana*, Blu Edizioni, Torino 2005
- [7] *Webster's New Encyclopedic Dictionary* BD & L, New York 1994
- [8] Lodge D. M., In: Kareiva P. M., Kingsolver J. G., Huey R. B (Eds.) *Biotic Interactions and Global Change*, Sunderland, Sinauer Associates Inc. Publishers 1993, p. 367-87
- [9] The Angiosperms Phylogeny Group. *Botanical Journal of the Linnean Society* 2003, 141, 399-436
- [10] Kramer K.U., Green P.S., Goetz E., In: Kubitzki K. (Ed.) *The Families and Genera of Vascular Plants*, Springer-Verlag, New York 1990
- [11] Lauber K., Wagner G., *Flora Helvetica*, P.Haupt, Berna, Switzerland 2001
- [12] Hocking G.M., *A Dictionary of Natural Products* Plexus Publishing Inc, Medford, NJ 1997

- [13] Mukherjee P.K., *Quality Control of Herbal Drugs*, Business Horizons, New Delhi 2002
- [14] Tagwirevi D., Ball D.E., *Hum Exp Toxicol.* 2001, 20, 189-192
- [15] Arditti J., Rodriguez E., *J. Ethnopharmacol* 1982, 5, 293-302.
- [16] Fochtman F.W., Manno J.E., Winek C.L., Cooper J.A., *Toxicology and Applied Pharmacology* 1969, 15, 38-45
- [17] Minciullo P.L., Fazio E., Patafi M., Gangemi S., *Contact dermatitis* 2007, 56, 46-47
- [18] Zayed S.M., Farghaly M., Soliman S.M., Gotta H., Sorg B., Hecker E., *J.Cancer Res. Clin. Oncol.* 2001, 127, 40 -47
- [19] Vogg G., Mattes E., Rothenburger J., Hertkorn N., Achatz S., Sandermann H. jr., *Phytochemistry* 1999, 51, 289-295
- [20] Meier PJ, Gossweiler B., Jaspersen-Schib JR, Lorent JP., *Ther Umsch.* 1992, 49, 79-85.
- [21] <http://www.centres-antipoison.net/>
- [22] Wolfle J, Kowalewski S., *Vet Hum Toxicol.* 1995, 37, 367-368.
- [23] Bronstein A.C., Spyker D.A., Cantilena L.R. jr, Green J., Rumack B.H., Heard S.E., *Clin.Toxicol.* 2007, 45, 815-917