The family is represented in Egypt by 2 genera and 5 species (Boulos, 2005).

8.1. *NARCISSUS* L.

Proximate Composition and Proteins

The dry matter of the bulbs of 3 varieties of *Narcissus* contained ash, 2.349-2.925; N, 1.036-1.0421; K_2O, 0.745-0.951; P_2O_5, 0.326-0.470 and CaO, 0.511-0.617 % (Handley and Hargrave, 1934-1935). Calcium oxalate crystals were abundantly present in bulb scales and the shoot sap of *Narcissus* cv. 'garden giant'. The calcium oxalate crystals were distributed in every part of the plant including tunics, shoot, flowers, basal plate, and roots (Ruamrungsri *et al*., 1997).

The growth and development of *Narcissus assoanus* was studied during its ontogeny (Llabres *et al*., 1987). Nitrogen levels in several fractions as well as as the free amino acid content were analysed both for the aerial part and the bulb. The maximum content of N in the aerial part occurs during flowering, while in the bulb it occurs at the end of the period of development. The most abundant free amino acids (accounting for half of the total amount) are glutamic, γ-aminobutyric and aspartic acids in the aerial part, and glutamic acid and arginine in the bulb. The maximum free amino acids occurs during the vegetative period (Llabres *et al*., 1987). Protein was used as an aid in characterization of closely related species of *Narcissus* (Gonzalez-Aguilera *et al*., 1986) as well as in varietal characterization (Bhargava *et al*., 1987).

Carbohydrates

Narcissus poeticus contains 1% sucrose in the fresh leaves together with dextrose and other soluble sugars (Kylin, 1918). Galactose, mannose, levulose, lactose, maltose and sucrose were indentified in seed primordial of flowers of *Narcissus pseudonarcissus* (Schildknecht and Benoni, 1963). The bulbs of *Narcissus pseudonarcissus* contain a fructoside which is very similar or identical with asphodeloside (Belval, 1937). Enzymatic hydrolysis of the glucofructosan of *Narcissus* revealed that glucose occurs in the α-form (Belval and de Grandchamp-Chaudun, 1948).

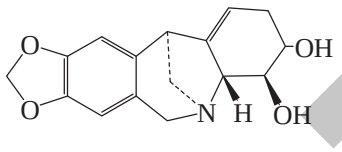
Narcissus bulbs have been early reported as a commercial source of substitutes for potato starch, but the yield is very low and the product is unfit for food purposes (Verkade, 1918). The carbohydrate complex of *Narcissus poeticus* includes a water-soluble polysaccharide, a natively acetylated glucomannan and α-glucan of the amylopectin type (Rakhimov and Zhauynbaeva, 1997). A homogenous native acetylated glucomannan of molecular weight 32,000 with a glucose mannose ratio of 1:30 was isolated from bulbs of *Narcissus poeticus*. It is a linear chain polymer consisting of β-1→4-bound D-glucose and D-mannose pyranose units and the *O*-Ac groups are localized on C-2, C-3 and C-6 hydroxyls in certain anhydromannose units (Zhaubnbaeva *et al*., 2003a; Rakhimov *et al*., 2004).

Alkaloids

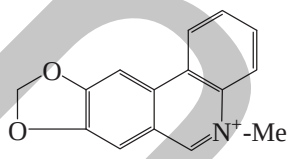
Alkaloids have been isolated from several *Narcissus* species (daffodil). Boit and Doepke (1957) reported the isolation of several alkaloids from 19 species of trumpet narcissus, 12 species cup narcissus and 8 species of filled narcissus (doubles). Charkasov *et al*. (1989) presented data on the galanthamine content of aerial organs and bulbs of 15 garden varieties of *Narcissus* and concluded that many of them can be used as pharmaceutical raw materials. The alkaloid narciclasine (**4**) with marked antimitotic activity was isolated from the bulbs of

several varieties of *Narcissus* (Ceriotti *et al*., 1967). The bulbs of *Narcissus pseudonarcissus* have been identified as a potential source of galanthamine, a benzazepine alkaloid used as drug to relieve symptoms of Alzherimer (Lubbe *et al*., 2010). Several *Narcissus* cultivars have been evaluated and reviewed as sources of a potential source of galanthamine (e.g. Moraes-Cerdeira *et al*., 1997; Cherkasov and Tolkachev, 2002; Moraes, 2002). The alkaloids isolated from *Narcissus* species have been reviewed by several authors (e.g. Kreh, 2002, Viladomat, 2002). Examples of the alkaloids isolated from *Narcissus* species are shown in Table 3. In addition, alkaloids have been isolated from several other *Narcissus* species e.g.:

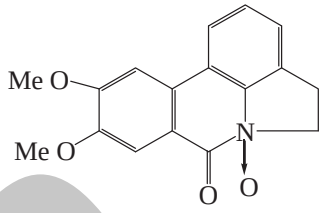
1- *Narcissus bulbocadium* L. (Seijas *et al*., 2004a).
2- *Narcissus gracilis* (Cherkasov, 1977).
3- *Narcissus incomparabilis* (Boit and Ehmke, 1956a; Cherkasov, 1977).
4- *Narcissus lobularis* (Cherkasov, 1977).
5- *Narcissus poeticus* (Cherkasov, 1977).
6- *Narcissus triandrus* L. (Seijas *et al*., 2004b).
7- *Narcissus* cv. Ice Follies (Abou-Donia *et al*., 2002a).
8- *Narcissus* cv. Salome (Almanza *et al*., 1996).
9- *Narcissus* var. fortune (Tokhatabaeva *et al*., 1987).
10- *Narcissus* 'Sir Winston Churchil' (Ingkaninan *et al*., 2000).



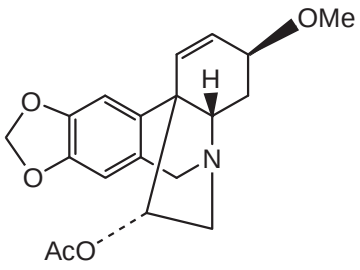
84 Nangustine



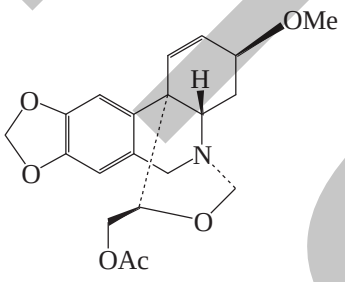
85 Bicolorine



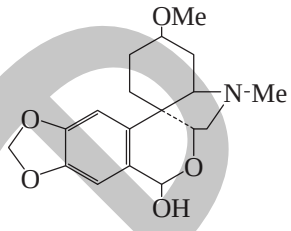
86 Oxoassoanine *N*-oxide



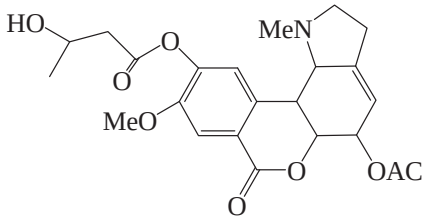
87 11-*O*-Acetylhaemanthamine



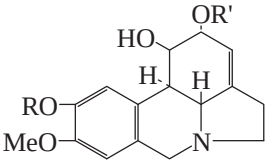
88 Bujeine



89 Pretazettine



90 Dubiusine



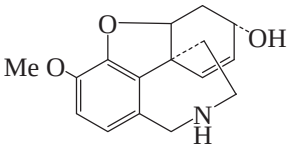
91 Goleptine R=H, R'=Me
92 Golceptine R=R' = H

Table 3- Alkaloids of some *Narcissus* species

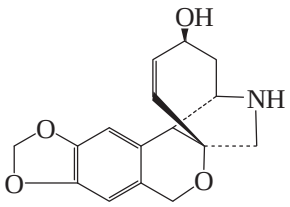
Species	Plant Part	Alkaloids	References
1. *Narcissus assoanus*		Assoanine, oxoassoanine, pseudolycorine, 1-*O*-acetylpseudolycorine and 2-*O*-acetylpseudolycorine	Llabres *et al*. (1986b); Viladomat *et al*. (1986)
2. *Narcissus angustifolius* subsp. *transcarpathicus*	B	Nangustine (**84**), pancracine (**65**) and others	Labrana *et al*. (2002)
3. *Narcissus bicolor*	B	Bicolorine (**85**), 5,6-dihydrobicolorine, oxoassoanine *N*-oxide (**86**), pretazettine, 9-*O*-demethylhomolycorine and 3-epimacronine	Viladomat *et al*. (1990)
4. *Narcissus bujei*	Wp	11-*O*-Acetylhaemanthamine (**87**), bujeine (**88**), *O*-methyllycorenine and others.	Labrana *et al*. (1998).
5. *Narcissus cantabricus*		Cantabricine, crinamine (**37**), 6α-hydroxybuphanisine, 6β-hydroxypuhanisine, pretazettine (**89**) and vittatine	Bastida *et al.* (1995d)
6. *Narcissus confuses*	B	Homolycorine and 9-*O*-demethylhomolycorine. Galanthamine, *N*-formylgalanthamine, pretazettine, and haemanthamine	Bastida *et al*. (1987a) Bastida *et al*. (1987b); Lopez *et al*. (2003)
7. *Narcissus cyclamineus* hybrids (4 varieties)	B	Galanthine, pluviine, hemanthidine, tazettine, lycorine, lycorenine, narcissidine and lycoramine	Boit *et al*. (1957)
8. *Narcissus dubius*		Dubiusine (**90**)	Bastida *et al.* (1988a)
9. *Narcissus folli*	B	Lycorine and tazettine	Abduazimov and Yunusov (1967)
10. *Narcissus hybridus* (15 cultivars) (6 varieties) var. fortune	L B,L L	Galanthamine Galanthamine Lycorine, galanthamine and haemanthamine	Cherkasov *et al.* (1986). Maisuradze *et al.* (1985) Gorbunova *et al*. (1984)
11. *Narcissus jacetanus*	Wp	Assoamine, oxoassomine, lycorine and pseudolycorine	Bastida *et al.* (1988b)

Table 3- Alkaloids of some *Narcissus* species (cont.).

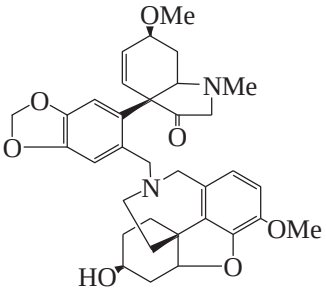
Species	Plant Part	Alkaloids	References
12. *Narcissus jonquilla* hybrid *Golden Sceptra*		Galanthamine, lycorenine, hemanthamine, tazettine, hippeastrine, oduline, homolycorine, masonine, poetarianine, goleptine, golceptine and jonquelline.	Doepke (1963b); Doepke and Dalmer (1965)
Hybrids		Goleptine (**91**), golceptine (**92**) lycorine, galanthamine, tazettine, hippeastrine, oduline, hemanthamine, homolycorine, lycorenine, *N*-demethylgalanthamine, *N*-demethyllycoramine, lycoramine and narwedine	Boit *et al.* (1957); Doepke (1964); Gotti *et al*. (2006)
13. *Narcissus kristalli*	B	Galanthamine, (±)-narwedine and (+)-narwedine,	Abduazimov and Yunusov (1967).
14. *Narcissus leonensis*	Wp	Epinorgalanthamine (**93**) and epinorlycoramine	Bastida *et al*. (1993)
15. *Narcissus monozigarmendiae*	Wp	Homolycorine, lycorenine and *O*-methyllycorenine	Codina *et al*. (1993)
16. *Narcissus nivalis*	Ap	Galanthamine, *N*-demethylgalanthamine and *O*-methylpseudolycorine.	Bastida *et al*. (1990b)
17. *Narcissus obesus*		Bicolorine, 5,6-dihydrobicolorine, epimacronine, galanthamine, pretazettine (**89**), hemanthamine and obesine (**94**)	Viladomat *et al.* (1992)
18. *Narcissus odorus* var. *rugulosus*		Rudoline and penarcrine	Boit *et al.* (1958)
19. *Narcissus pallidiflorus*	Wp	Pallidiflorine (**95**), 5,6-dihydrobicolorine, hemanthamine, homolycorine, 8,*O*-demethylhomolycorine and pretazettine	Codina *et al*. (1990)
20. *Narcissus pallidulus*	Ap	Mesembrenone (**96**) and roserine	Bastida *et al*. (1989, 1992b)
21. *Narcissus panizzianus*	B,Ap	Homolycorine, galanthine, pretazettine, papyramine (**97**) and 6-*epi*-papyramine	Bastida *et al*. (1990a)



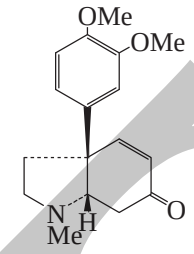
93 Epinorgalnthamine



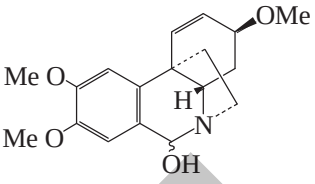
94 Obesine



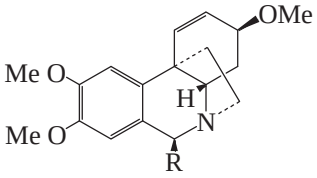
95 Pallidiflorine



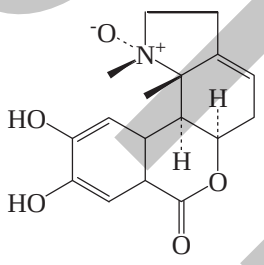
96 Mesembrenone



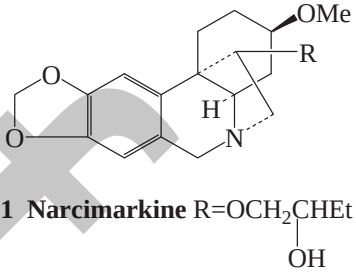
97 Papyramine



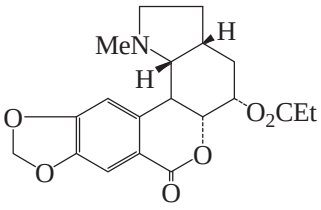
98 *O*-Methylpapyramine R=OMe
99 *O*-Methylmaritidine R=H



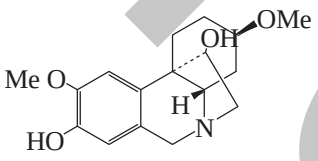
100 9-*O*-Demethylhomolycorine *N*-oxide



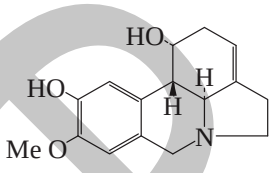
101 Narcimarkine R=OCH_2CHEt (OH)



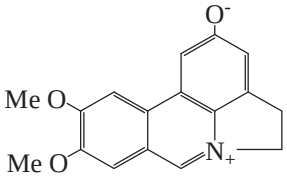
102 Poetinatine



103 (+)- Narcidine



104 10- Norpluviine



105 Tortuosine

Table 3- Alkaloids of some *Narcissus* species (cont.)

Species	Plant Part	Alkaloids	References
22. *Narcissus papyraceus*	Ap	Papyramine, lycorine, pseudolycorine, homolycorine, 9-*O*-demethylhomolycorine, *O*-methylpapyramine (**98**), *O*-methylmartidine (**99**) and 9-*O*-demethylhomolycorine-*N*-oxide (**100**)	Suau *et al*. (1990b)
23. *Narcissus papyramine*	B	Lycorine, tazettine, galanthamine, lycoramine, pseudolycorine and papyramine (**97**)	Hung *et al*. (1981).
24. *Narcissus poeticus*	B	Poetamine, poetaminine, and poetaricine Narcimarkine (**101**), narcissidine	Doepke (1963a) Boit and Stender (1954a); Doepke and Edda (1981)
25. *Narcissus poeticus* var. *ornatus*	B	Homolycorine, poetinatine (**102**)	Boit and Stender (1954b); Doepke and Nguyen (1974)
26. *Narcissus primigenius (=Narcissus pseudo-narcissus* subsp. *primigenius*	Wp	Hmolycorine, 8-*O*-demethylhomolycorine, hemanthamine, and 8-*O*-demethylmartidine	Bastida *et al*. (1994)
27. *Narcissus pseudonarcissus* (Common daffodil, King Alfred daffodil)	B	Narcissine (lycorine), narcidine (**103**), hippeastrine, narcissidine, 8-*O*-demethylhomolycorine, *O*-methyloduline, *N*-demethyl masonine, 10-norpluviine(**104**), 10-acetyl-10-norpluvine,1,10-diacetyl-10-norpluvine and *O*-acetylgalanthamine galanthamine, lycoramine, narwedine, heamanthamine and tazettine	Ewins (1911); Tojo (1991); Kreh and Matusch (1995); Kreh *et al*. (1995); Gotti *et al*., 2006
28. *Narcissus radinganorum*	Wp	Homolycorine, 8-demethylhomolycorine and 9-*O*- demethyl-martidine	Bastida *et al*. (1988c)
29. *Narcissus requienii*	Ap	Pseudolycorine, 2-*O*-acetylpseudolycorine and 1-*O* acetylpseudo-lycorine	Llabres *et al*. (1986a)

Table 3: Alkaloids of some *Narcissus* species (cont.)

Species	Plant Part	Alkaloids	References
30. *Narcissus serotinus*		4-Methoxy-5-methyl-1,2,3,5,6,6α-*R*-hexahydro-[1,3]dioxolo [4,5´,6,7]isochromeno[3,4-c]indol-8-one (= isomer of epimacronine)	Vrondeli *et al.* (2005)
31. *Narcissus tortifolius*		Homolycorine, galanthamine, 8-*O*-demethylho-molycorine and 9-*O*-demethyl-2α-hydroxyhomolycorine	Bastida *et al.* (1990c)
32. *Narcissus tortuosus*	Wp	Tortuosine (**105**)	Bastida *et al.* (1995c)
33. *Narcissus triandrus* hybrids (3 varieties)	B	Hemanthamine, lycorenine, lycorine, homolycorine, tazettine and galanthamine (**33**)	Boit *et al.* (1957)
34. *Narcissus vasconicus*	Wp	Lycorine, homolycorine, 8-*O*-acetylhomolycorie and vasconine	Bastida *et al.* (1992a)

Ap: aerial parts; B: bulbs; L: leaves; Wp: whole plant

Essential Oils

The study of the constituents responsible for the characteristic odour of the flowers of *Narcissus* species has been carried out. Early, Igolen (1942) identified eugenol, benzyl alcohol and cinnamyl alcohol from the essence of *Narcissus poeticus* L. flowers. The distillate fraction of narcissus concrete has been reported to contain as chief components eugenol, benzaldehyde, free and esterified benzoic acid, benzyl and cinnamic alcohol (Igolen, 1948). Living narcissus flowers contain benzyl acetate (44.0%), 3,4- and 3,5-dimethoxytoluene (35.0%), and indole (5%), whereas picked flowers contain benzyl acetate (30-43%), 3,4- and 3,5-dimethoxytoluene (18-39.5%) and indole (0.3-1.0%) (Mookherjee *et al.*, 1989). The variation in *Narcissus* aroma composition during blossoming was studied by Huang and Feng (2004). They identified 55 aroma compounds, such as benzaldehyde, limonene, linalool, benzyl acetate, etc. Benzyl acetate (19.36 %) was reported as the major component of the volatile oil of *Narcissus serotinus* (Melliou *et al*., 2007). The limitations of using narcissus flowers in perfumery have been discussed and reviewed by Remy (2002). The review also describes the history, flower gathering extraction and olfactory description of narcissus flowers.

Other Constituents

β-Carotene was found in coronas of certain cultivated varieties of *Narcissus* in concentrations up to 3 mg/g based on the fresh weight or 2 % of the dry weight. In red fringes from the coronas of *Narcissus poeticus recurvus*, β-carotene comprised about 16.5 % of the dry weight. Other pigments, probably free and esterified carotenoids, were present in amounts approximately equivelant to half the β-carotene contents. Pigments from trumpets of yellow forms (daffodil), although presumably carotenoids, included only small proportions of β-carotene (Booth, 1957). Kuhn (1970) identified *trans*-β-carotene in the corona of *Narcissus poeticus*. The qualitative and quantitative distribution of carotenoids of the floral parts of the narcissus Scarlet Elegance, the daffodil King Alfred, and the tulip Golden Harvest were studied by Valadon and Mummery (1968). β-Carotene, lutein, or epoxy-β-carotenes were usually the main pigments, depending on the floral part and on the flower. When β-carotene was the major pigment, there were only small amounts of, or sometimes no, epoxycarotenes. Anthers, stigmas, and styles of the 3 flowers did not possess any specific carotenoids but in some cases contained appreciable amounts of epoxycarotenoids. Two probable isomers of 5,6:5',6'-diepoxy-β-carotene were isolated and found together in various parts of the tulip (Valadon and Mummery, 1968). (*all-E*)-Lutein was the major carotenoid of the petals of a yellow garden hybrid daffodil. Minor constituents included phytoene, phytofluene (*all-E*)-β-carotene, (9*Z*)-lutein, (9'*Z*)-lutein, (13*Z*)-lutein, violaxanthin and luteoxanthin (Berset and Pfander, 1985). Helenien (a dipalmitic acid ester of lutein) (0.01 %) was identified in the flowers of *Narcissus pseudonarcissus* (Tarpo and Cucu, 1961).

Mannose-specific lectins have been isolated from *Narcissus pseudonarcissus* (Van Damme *et al*., 1988,1991; Stewart *et al*., 1991). A survey of about 30 cultivars and species of *Narcissus* demonstrated that they all contain over 50 different lectin polypeptides and that there are pronounced inter- and intraspecific differences in the isolectin patterns (Van Damme and Peumans, 1990). Mannose-specific lectins (MSLs) were isolated from the bulbs of 27 species of wild Spanish *Narcissus* and compared to the MSL from daffodil (*Narcissus pseudonarcissus* NPA). Haemoagglutination assay showed that MSLs exhibited activities up to four times greater than that displayed by NPA and MSLs derived from other species such as *Galanthus nivalis* (snowdrop) and *Allium ursinum* (ramson) (Lopez *et al*., 2002b).