ISOQUINOLINE ALKALOID BIOSYNTHESIS Phenylalanine, tyrosine and tryptophan biosynthesis L-Tyrosine **►**O°2Lycorine 3,4-Dihydroxybenzaldehyde *O°2Crinine K00422 Tyramine K00501 - | 2.1.1.- | **- ▶ ⊙** Galanthamine **PO** 4-Hydroxyphenylpyruvate 4'-Methylnorbelladine N-Demethylnarwedine N-Demethylgalanthamine Norbelladine L-Dopac 💁 4.1.1.80 K00505 1.14.13.-4-Hydroxydihydrocinnamaldehyde 4-Hydroxyphenylacetadehyde°І 65 Dopamine, Autumnaline Isoandrocymbine O-Methylandrocymbine N-Formyldemecolcine Demecolcine Deacetylcolchicine Colchicine Floramultine Tyrosine metabolism 2.1.1.-**▶○** Kreysigine K13382 K13371... K00276 **O**Secologanin Ankorine (S)-Norcoclaurine \mathfrak{P}° 3,4-DHPAA K13382 K13383 4.3.3.4 4.3.3.3 (S)-Norlaudanosoline 💇 (S)-Coclaurine Protoemetine Deacetylipecoside 🖔 2'-Norberbamunine 🔾 🔫 Deacety- of lisoipecoside Emetine 🕶 (R)-N-Methylcoclaurine spontaneous spontaneous **O**Cephaeline Guattegaumerine © K13387 K13384 ♥ (R)-Norre-©°ticuline K13387 Demethyl- o Berbamunine 💇 🖜 Deoxy-tubulosine Demethyl- 🗘 Tubulosine alangiside (S)-N-Methylcolaurine K13385 O Papaverine (S)-6-O-Methyl-norlaudanosoline (S)-3'-Hydroxy- °ॐ⊶ N-methylcoclaurine | K13388 2.1.1.121 (S)-Nororientaline Alangiside Alangimarckine Isoalangiside K13386 K13386 °�(S)-Norreticuline (S)-Reticuline, Tetrahydropalmatine K13388 1.3.3.8 K13390 K00307 K13389 2.1.1.89 1.5.-.-(S)-Tetrahydrocolumbamine Columbamine Palmatine ் ල්¹(S)-Cory-tuberine 2.1.1.147 **►••** Corydaline 1.3.3.8 • 1,2-Dehydro-reticulinum ^c**©**²Laudanine (S)-Scoulerine K13390 K13399 2.1.1.-1.5.1.27 1.21.3.2 1.1421.2 Berberine (S)-Canadine 1.5.1.31 ► ○ (R)-Canadine °♥⁴(S)-Cheilan-thifoline 1.3.3.8 **₽**♥*(R)-Reticuline Magnoflorine K13395 K13388 K13391 °**Ф**⁵(S)-Stylopine °**Ф**Salutaridine (R)-Norreticuline K13396 K13392 ுை(S)-cis-N-Methylcanadine ୍**ଧ**୍ୟ(S)-cis-N- ୍ | Methylstylopine °**⇔**Salutaridinol K13393 1.14.13.37 1.14.13.37 ေနနှာ Salutaridinol **்**Protopine °**O**°Allocryptopine <u>spontaneous</u> 1.14.13.55 Ф6-Hydroxyprotopine Neopinone 🗨 ^c♥³Thebaine <u>spontaneous</u> K14975 spontaneous Dihydro-sanfuinarine dihydrosanguinarine chelirubine 12-Hydroxy-dihydrochelirubine Dihydromacarpine °**Ф***Oripavine 1.14.13.57 - 21.1.11와 Codeinone © 1.5.3.12 1.5.3.12 1.5.3.12 K13394 K14976 *Morphinone Sanguinarine Ġ Codeine 💇 Macarpine Chelirubine K14975 K03378 **►**© Morphine 00950 3/14/14 (c) Kanehisa Laboratories