ISOQUINOLINE ALKALOID BIOSYNTHESIS Phenylalanine, tyrosine and tryptophan biosynthesis L-Tyrosine **₩**©°Lycorine 3.4-Dihydroxybenzaldehyde O Crinine K00422 Tyramine K00501 - 2.1.1.- For Galanthamine ┨ 1.1.1.- ┠ **PO** 4-Hydroxyphenylpyruvate 4'-Methylnorbelladine N-Demethylnarwedine N-Demethylgalanthamine Norbelladine L-Dopæ**∳**⁵ 4.1.1.80 1.14.13.-4 Hydroxydihydrocinnamaldehyde 4-HydroxyphenylacetadehydeІФ° Dopamine, Autumnaline Isoandrocymbine O-Methylandrocymbine N-Formyldemecolcine Demecolcine Deacetylcolchicine Colchicine **▶**©[®] 2.1.1.-Floramultine Tyrosine metabolism 2.1.1.-**-►**O Kreysigine K13382 K13371... Secologanin Ankorine (S)-Norcoclaurine © 3,4DHPAA 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 Guattegaumerine 💇 K13387 **©**Cephaeline ♥ (R)-Norre-o ticuline K13387 Berbamunine 💇 Demethyl- o Demethyl- 🗘 Deoxy-tubulosine **T**ubulosine alangiside (S)-N-Methylcolaurine K13385 o Papaverine (S)-6-O-Methyl-norlaudanosoline (S)-3'-Hydroxy- © → N-methylcoclaurine K13388 2.1.1.121 (S)-Nororientaline Alangiside Alangimarckine Isoalangiside K13386 K13386 ံဇာန်(S)-Norreticuline (S)-Reticuline, Tetrahydropalmatine K13388 1.3.3.8 K13390 K00307 K13389 2.1.1.89 1.5.-.-(S)-Tetrahydrocolumbamine Columbamine Palmatine 2.1.1.147 **► ⊙** Corydaline ්ੴ¹(S)-Cory-tuberine 1.3.3.8 • 1,2-Dehydro-reticulinium °**©**°² Laudanine (S)-Scoulerine K13390 1.21.3.2 2.1.1.-1.5.1.27 1.1421.2 K13399 Berberine (S)-Canadine 1.5.1.31 ► • (R)-Canadine °**ூ**′(S)-Cheilan-thifoline 1.3.3.8 **₽**♥*(R)-Reticuline Magnoflorine K13395 K13388 K13391 K13396 °Ф'(S)-Stylopine ්**ජ්** Salutaridine (R)-Norreticuline K13396 K13392 ్తా(S)-cis-N- ్తా(S)-cis-N-| Methylstylopine | Methylcanadine °**⇔**Salutaridinol K13393 1.14.13.37 1.14.13.37 ්ණීනිalutaridinol **்**Protopine °**Ó**⁴Allocryptopine acetate spontaneous 1.14.13.55 Ф6-Hydroxyprotopine Neopinone 🗨 ^c♥³Thebaine spontaneous K14975 spontaneous Dihydro-sanfuinarine dihydrosanguinarine Chelirubine 12-Hydroxy-dihydrochelirubine Dihydromacarpine **▶○** 1.14.13*5*7 °**∲**'Oripavine ┥21.1.119ト Codeinone © 1.5.3.12 1.5.3.12 1.5.3.12 K13394 K14976 ° ✓ Morphinone Sanguinarine Ġ Codeine 💇 Chelirubine Macarpine K14975 K03378 **►**© Morphine 00950 3/14/14 (c) Kanehisa Laboratories