



# 7º ENIFarMed

Centro de Convenções Rebouças, São Paulo, SP  
20-21 de agosto de 2013

**Sessão Temática** – Sala Coral

## Inovação em síntese química

Moderadora: **Diva Arrepia**, Abifina

Palestrantes:

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LASSBio, INCT-INOVAR, UFRJ



**Sergio Falomir**, Nortec Química  
**Sergio Frangioni**, Blanver



# Sumário

1. Síntese orgânica & síntese de fármacos;
2. Aspectos *contemporâneos* da síntese;
3. Fármacos sintéticos:
  1. Dimensão & mercado;
  2. Particularidades;
4. Capacitação & limitações;
5. Agradecimentos

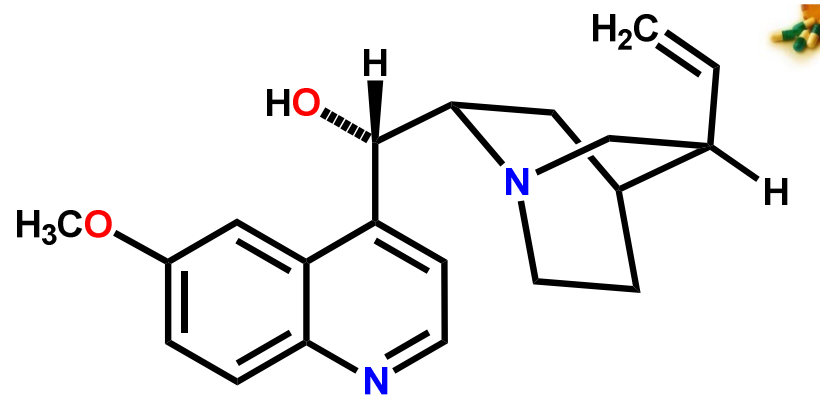


Síntese total  
multietapas;  
(Fase sólida, etc)  
Síntese assimétrica;  
Sustentabilidade

*Green chemistry;*  
C-C / C-O / C-N / C-S etc  
Grupos protetores;

\*R. B. Woodward, W. E. Doering, The Total Synthesis of Quinine,  
*J. Am. Chem. Soc.* **1945**, 67, 860;

\*\*G Stork et al, The First Stereoselective Total Synthesis of Quinine,  
*J. Am. Chem. Soc.* **2001**, 123, 3239;

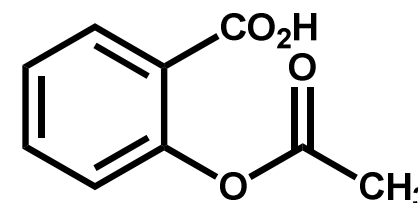


Quinina

(1945\*/2001\*\*)

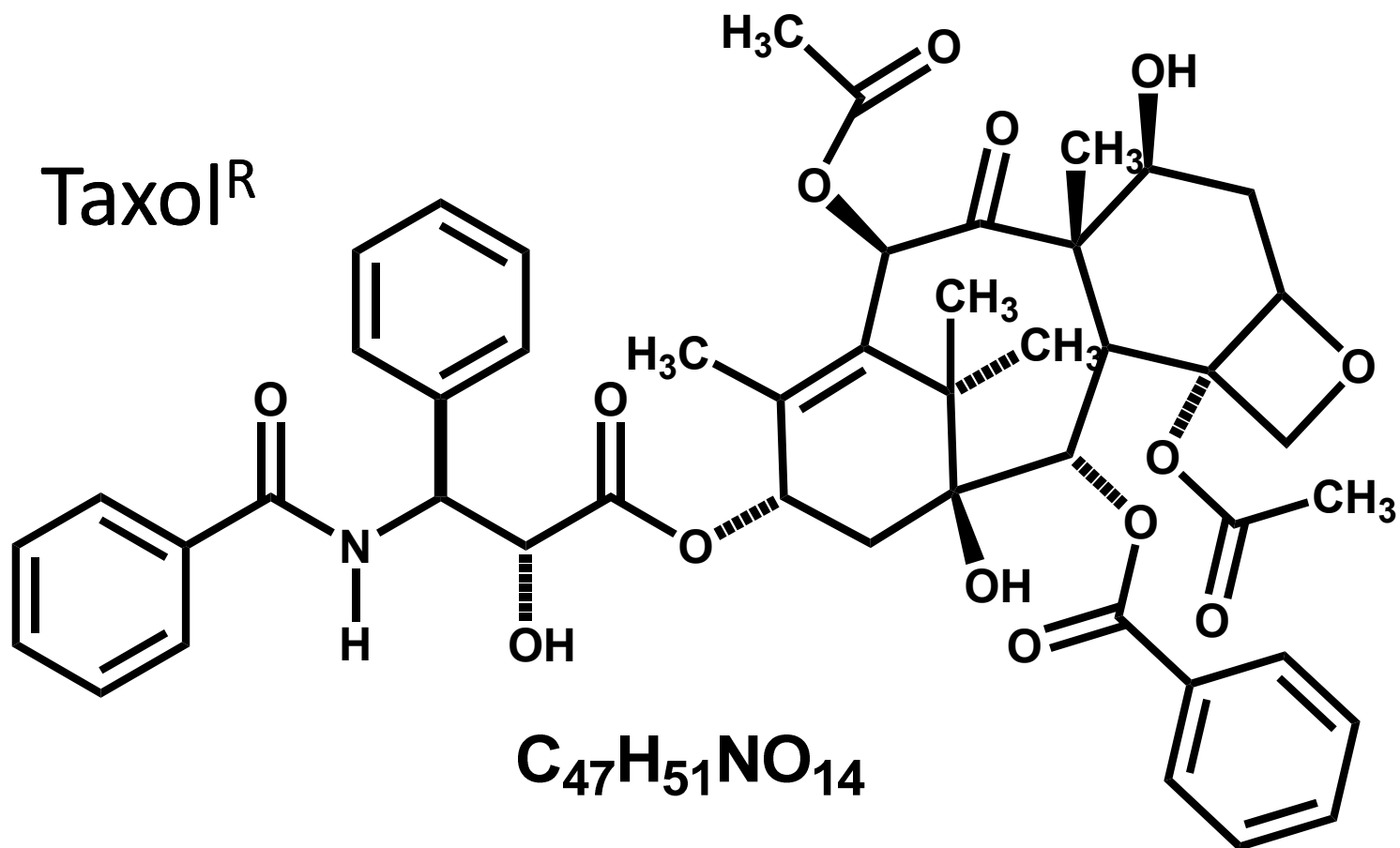


AAS





# Paclitaxel: síntese total!



K. C. Nicolaou et al., Total synthesis of taxol, *Nature* **1994**, 367, 630; R. A. Holton et al., First total synthesis of taxol. 2. Completion of the C and D rings, *J. Am. Chem. Soc.* **1994**, 116, 1599; J.J. Masters et al., A Total Synthesis of Taxol, *Angew. Chem.* **1995**, 34, 1723; P.A. Wender et al. The Pinene Path to Taxanes. 6. A Concise Stereocontrolled Synthesis of Taxol, *J. Am. Chem. Soc.* **1997**, 119, 2757.

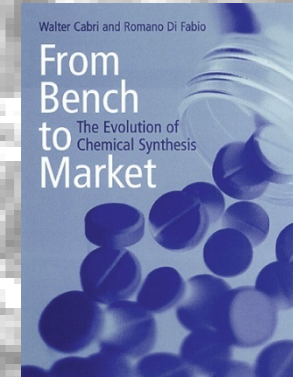
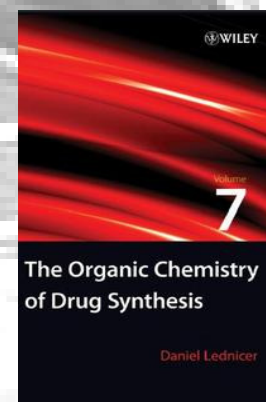
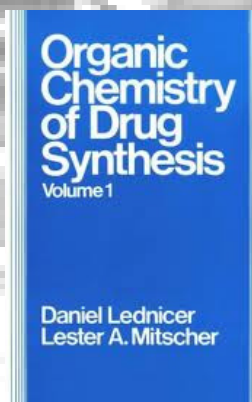
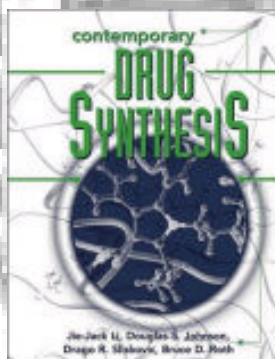
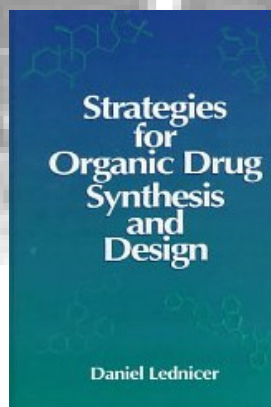
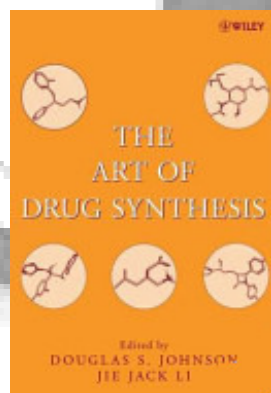
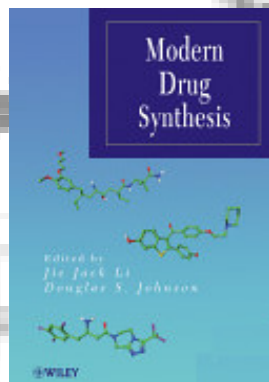


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>> 85% do arsenal terapêutico

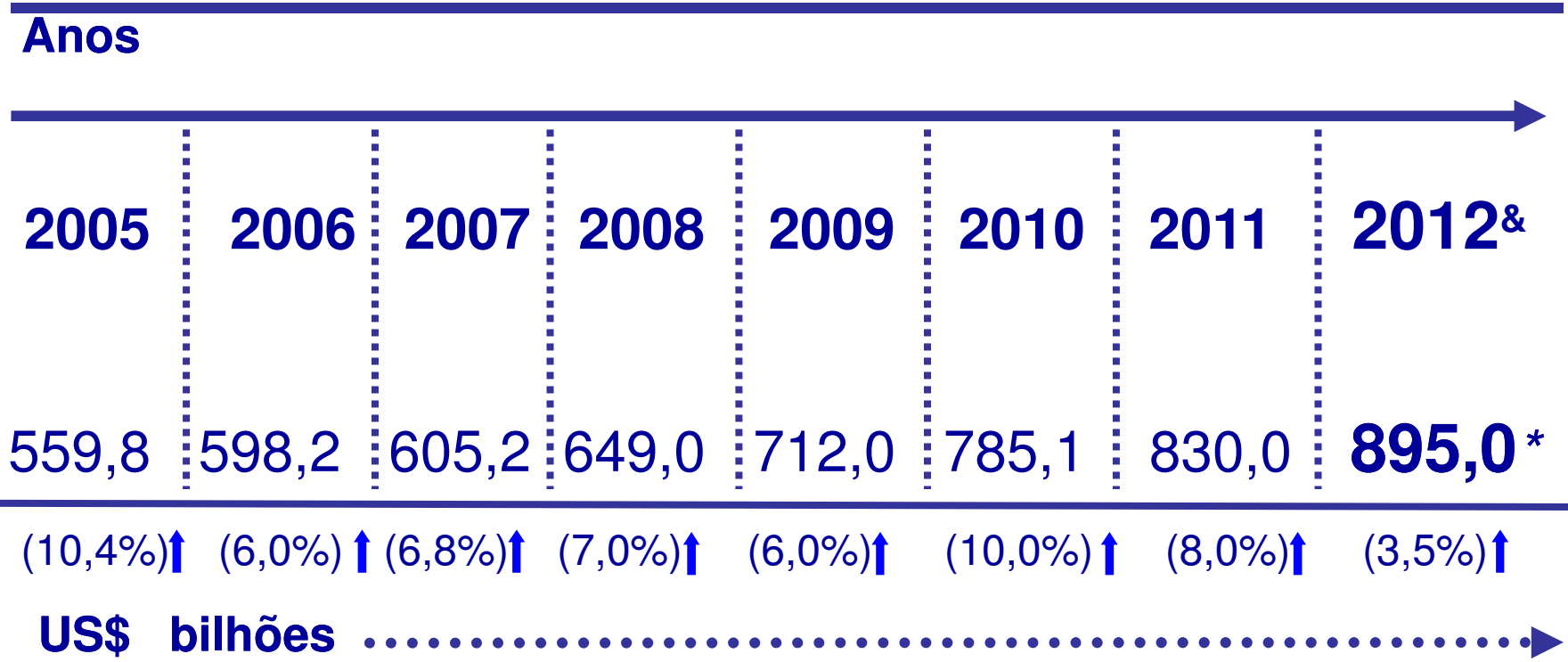
= Fármacos sintéticos

= US\$ 760 bi (2012)





# Mercado Farmacêutico Mundial



## América Latina:

*Brasil: ~3,0% (10º lugar) = US\$ 17,7 bilhões (ca. >20%)*

*Top-10: Co's US\$ 362,2 bilhões (-1,2%) / Fárm. US\$ 76,7 (-2,3%)*

\* Fonte: R Mullin *C&EN*, 2012, 90 (Dez. 10), p.15-20 18

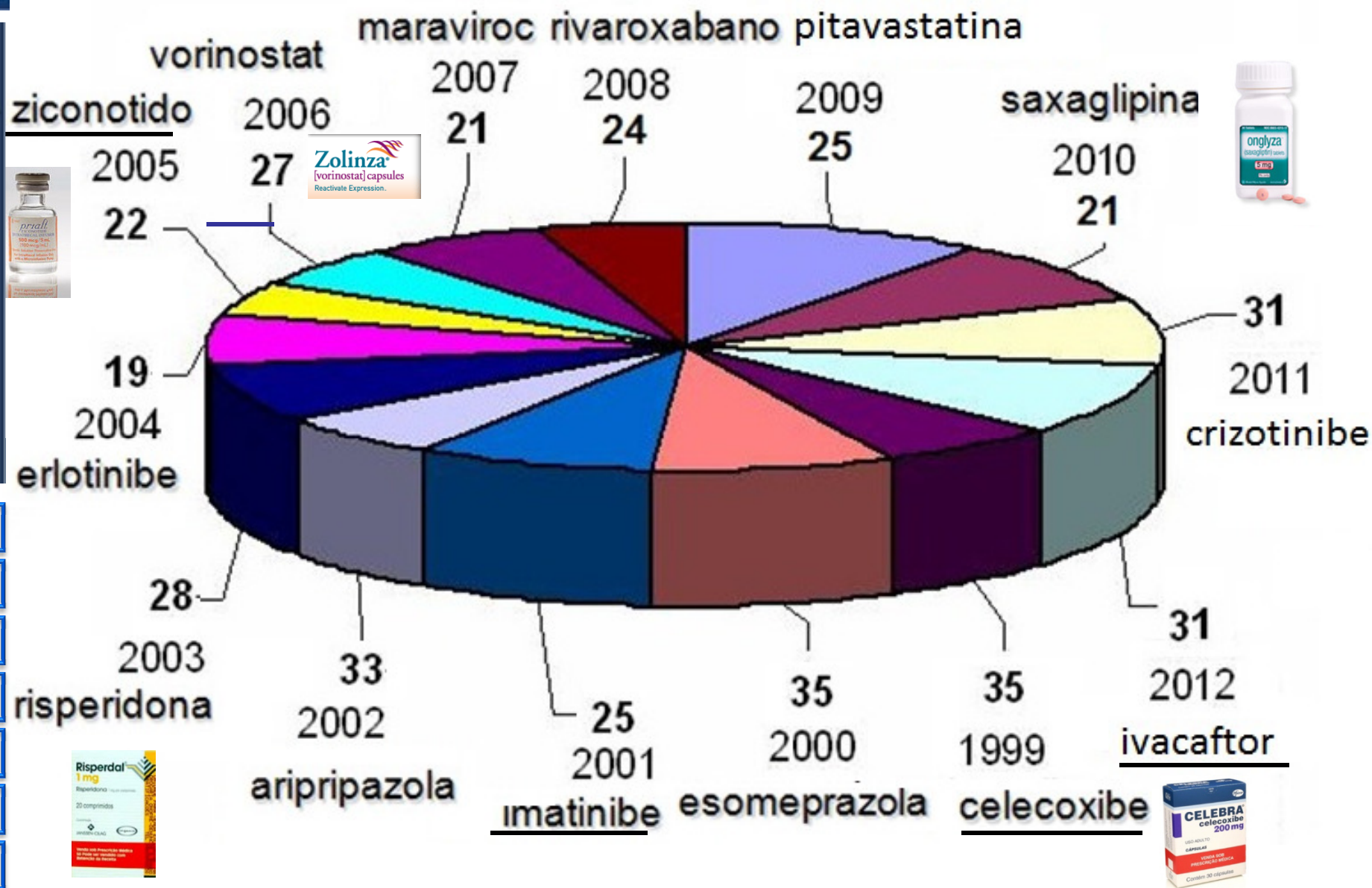
## & Principais classes terapêuticas:

- oncológicos** (6,0%)
- & anti-lipêmicos (4,1%)



# Novos fármacos lançados por ano / 1999-2012

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Fonte: Fonte: Annual Reports in Medicinal Chemistry, Market to Market, Volumes 35-47, ACS, 1999-2012



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# Inovação incremental



## Fármacos genéricos\*



Mercado brasileiro (25%)  
ca. US\$ 11,8 bi (2012; 11%)



## Insumos farmacêuticos ativos (IFA's)

“The art is to select [generics] that will be winners versus ones where there will be enormous competition...”

“Some fine chemicals companies make generic bulk actives and some don't, but no company can afford to ignore them”

M McCoy, Generic Drugs, C&EN 2002 (#13) 80, 23



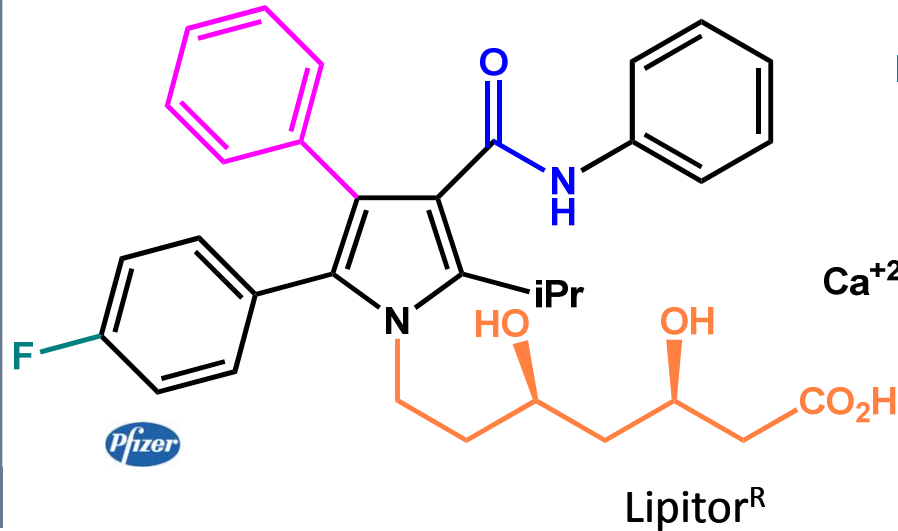


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# Inovação Incremental



*super blockbuster-drug*



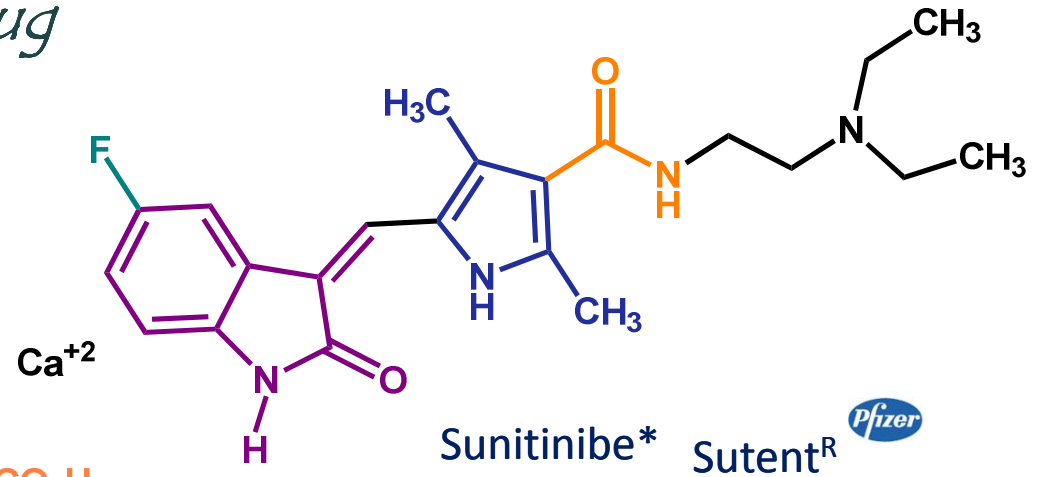
atorvastatina

Prof. Luiz Carlos Dias & Dr Adriano Siqueira  
UNICAMP

Vendas mundiais: US\$ >150 bilhões (1991-2011)

INPI Patente, 2011 (BR)

Prof. Luiz Carlos Dias  
UNICAMP  
(SUS)

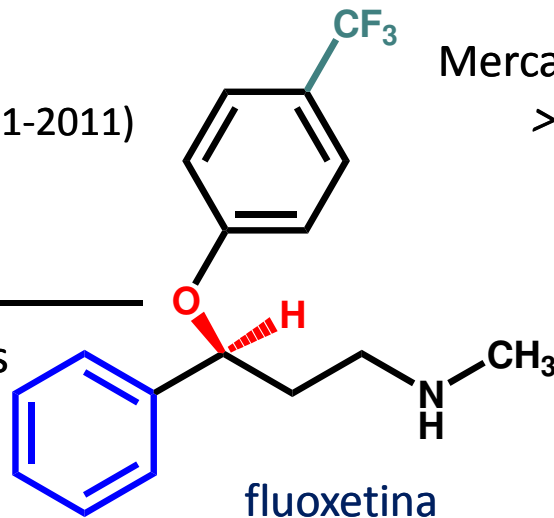


Prof. Angelo C. Pinto & Dra Barbara V. Silva  
UFRJ

Vendas mundiais: US\$ >1 bilhão (2010)

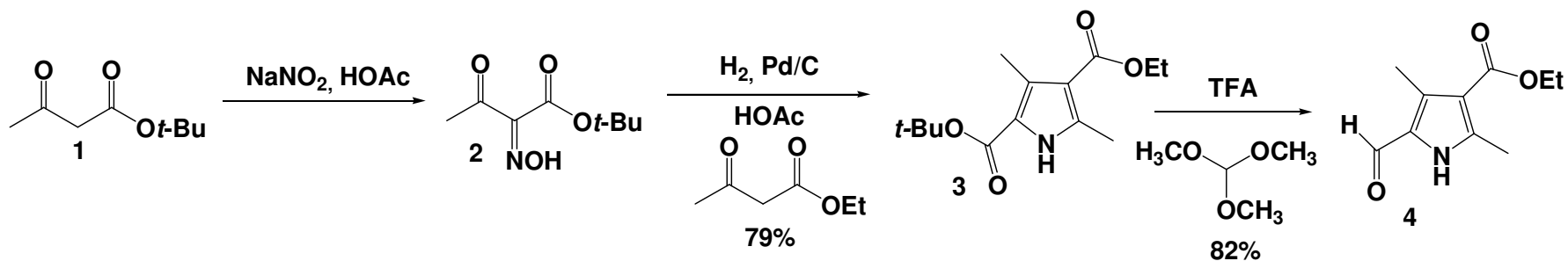
\*Patent US 7211600 (2001)

Mercado dos tinibes nos EUA  
>US\$ 18,5 bi (2009)

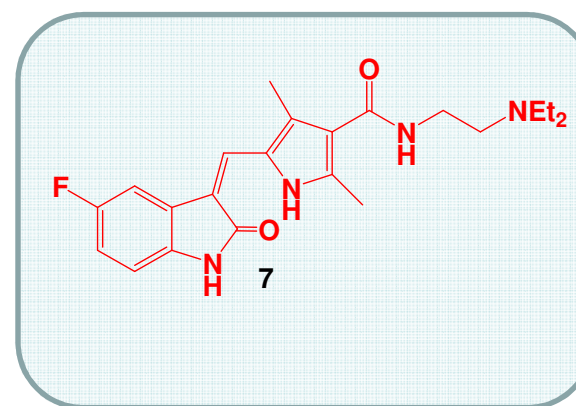
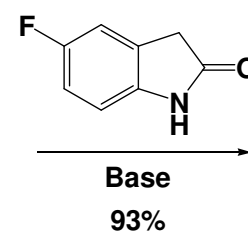
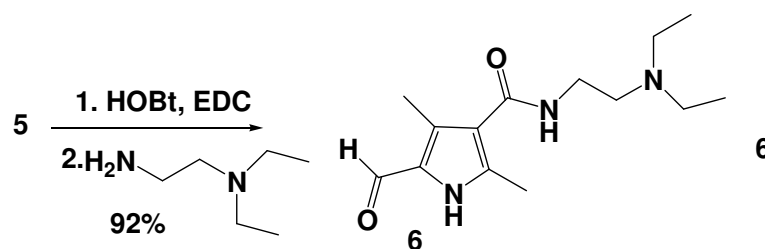
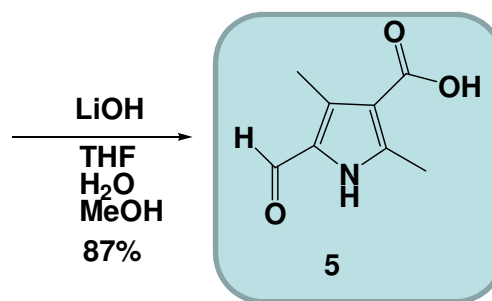


< "Caminho das Índias"





## Síntese do Sunitinibe



sunitinibe



# Patentes a expirar em 2012

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Marca <sup>R</sup>	Nome	Empresa	Vendas 2010 (US\$)
Seroquel	quetiapina	AZ	6,8 bi
Lexapro	escitalopram	Lundbeck	2,3
Provigil	modafanila	Teva	1,1
Plavix	clopidogrel	Sanofi/BMS	8,9
Singular	montelucaste	Merck	5,5
Actos	pioglitazona	Takeda	4,3
Diovan	valsartana	Novartis	4,1

Fonte :IMS

1996

simvastatina  
1986

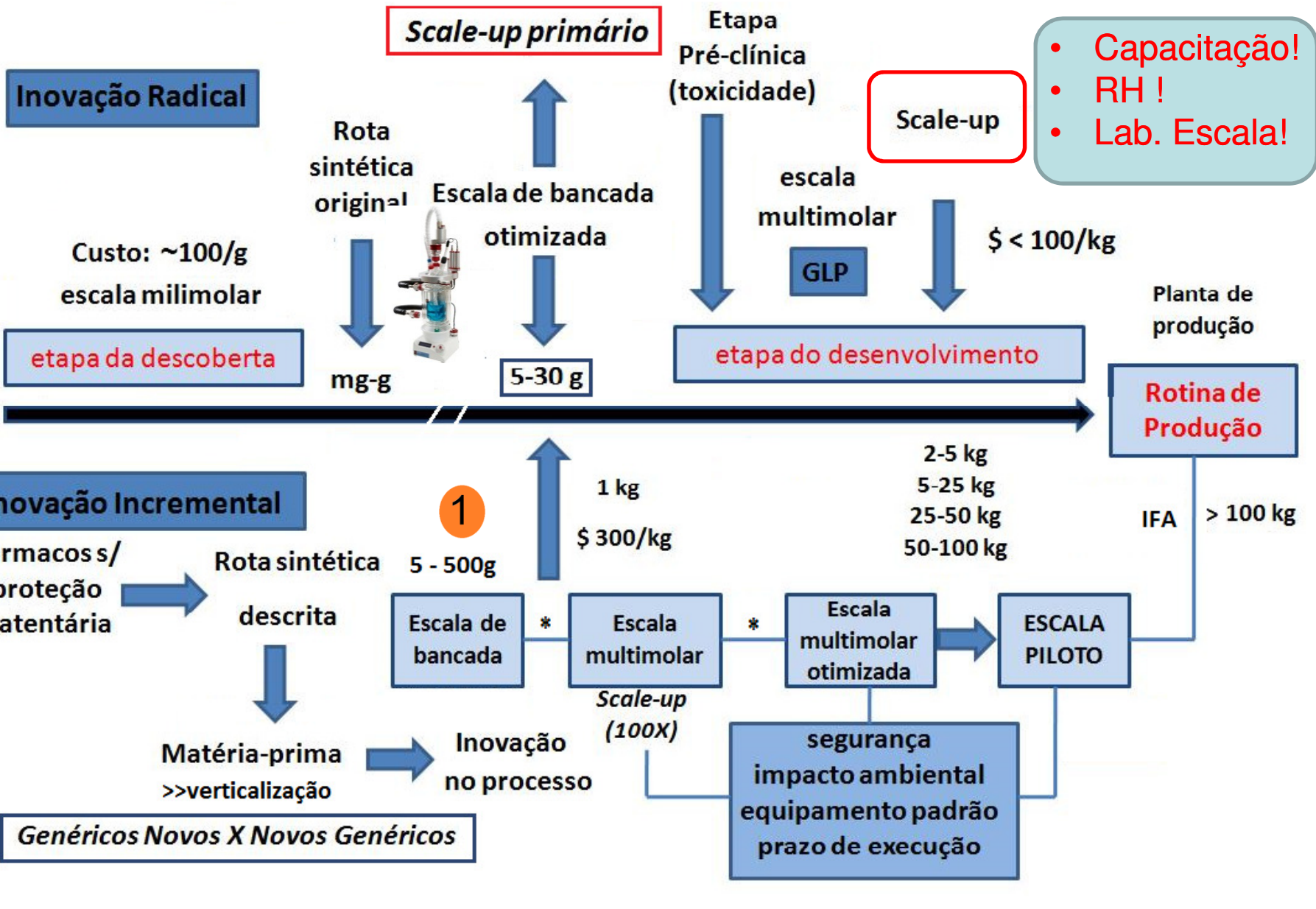
captopril  
1987

HO<sub>2</sub>C



# Principal gargalo da cadeia de inovação em fármacos no País

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# UFRJ



[www.inct-inofar.ccs.ufrj.br](http://www.inct-inofar.ccs.ufrj.br)

## Agradecimento\$:



Projeto CNPq nº 573.564/2008-6 «» FAPERJ nº E-26/170.020/2008

# Obrigado pela atenção!