Tetrahedron 68 (2012) 15–45

Contents lists available at SciVerse ScienceDirect

Tetrahedron

journal homepage: www.elsevier.com/locate/tet

Tetrahedron report number 958

Perspectives on the synthesis of organic carbamates

Devdutt Chaturvedi *

Natural Products Chemistry Division, North-East Institute of Science and Technology (CSIR), Jorhat 785006, Assam, India

ARTICLE INFO

Article history:
Received 6 September 2011
Available online 6 October 2011

Contents

* Corresponding author. Fax: +91 376 2370011; e-mail addresses: ddchaturvedi@rrljorhat.res.in, devduttchaturvedi@gmail.com.

0040-4020/$ – see front matter
doi:10.1016/j.tet.2011.10.001

1. Introduction

Organic carbamates are a stable class of compounds derived from the unstable carbamic acid (H_2N–COOH) by substitution of the amino and carboxyl moieties with various kinds of structurally diverse alkyl/aryl, aryl/alkyl or substituted alkyl/aryl and aryl/alkyl groups, and are identified by the presence of the linkage O–CO–NH–.[1,2] When the carbamate linkage is present in a cyclic system, this class of compounds are referred to as cyclic carbamates.[3] When the carbamate group is attached to any inorganic atom, either metallic or nonmetallic, such compounds are referred to as inorganic carbamates.[4]

Organic carbamates represent an important class of compounds showing various interesting properties. They find wide utility in areas, such as pharmaceuticals,[5] agrochemicals[6] (pesticides, herbicides, insecticides, fungicides etc.), as intermediates in organic synthesis,[7] for the protection of amino groups in peptide chemistry,[8] and as linkers in combinatorial chemistry.[9] Functionalisation of amines as carbamates offers an attractive method for the generation of derivatives, which may have interesting medicinal and biological properties.[10] Organic carbamates have been extensively used as intermediate for the synthesis of structurally diverse synthetic intermediates/molecules of biological significance.[11] Therefore, considerable interest has been generated in the recent past in the development of efficient and safe methodologies for carbamate ester synthesis.

Organic carbamates have frequently been employed as pharmaceuticals in the forms of drugs and prodrugs.[5a,12a] In recent years, several reports have indicated that the carbamate linkage present in the active pharmacophores of various structurally diverse molecules increases the biological activities of semisynthetic/synthetic natural/synthetic molecules.[13] Furthermore, the role of the carbamate linkage has been extensively studied in structurally diverse natural/semisynthetic molecules against various diseases, such as anticancer, antibacterial, antifungal, antimalarial, antiviral, anti-HIV, antiestrogenic, antiprogestational, antiosteoporosis, anti-inflammatory, antifilarial, antitubercular, antidiabetic, antiobesity, anticonvulsant, antihelminthes, anti-alzheimer drugs and CNS and CVS active agents (Fig. 1).[5c,d,14]

Some of the recent molecules in which the extensive role of incorporation of carbamates have been studied are discodermolide,[15] camptothecin[16] podophyllotoxin,[17] mitomycins,[18] vitamin-D_3,[19] geldanamycin,[20] fumagillin analogues,[21] butelinic acid,[22] amphotericin-B,[23] cephalosporins,[24] doxorubicin,[25] rapamycin,[26] anisomycin,[27] quiniclidine,[28] phytostigmine,[29] novobiocin,[30] oestradiol,[31] cholesterol,[32] sphingomyelin,[33] vancomycin,[34] marphinan,[35] rifampicin,[36] vulmbactin,[37] pregnelone,[38] himbacine,[39] iejimalides,[40] rhazinilam,[41] maytansine,[42] calcheamycin,[13c] combretastanin,[43] cyclosporin,[44] duocarmycins[45] etc. Beside the above mentioned molecules, several kinds of other structurally diverse natural/synthetic molecules have also been reported in the recent years wherein carbamates play crucial role in improving the biological activity profile than the parent molecules. Some of the important potential carbamates derivatives of structurally diverse biologically active anticancer,[19,46] antibacterial,[5e,47] antimalarial,[48] antidiabetic,[49] antioxidant,[50] antiinflamatory,[51] antitubercular,[52] antiprogestational,[53] anti-HIV,[17] anticougulant,[54] antiestrogenic,[55] CNS-active,[28] are depicted in Figs. 2–5, respectively. Several of natural, semisynthetic, synthetic lead molecules bearing carbamate functionality have been discovered in recent past and are in the various phases of drug development.[5,12a,13,56]

Although, some of the review articles on the different aspects on the chemistry of organic carbamates have been published but the review articles dealing synthetic aspects of the carbamates were only published long back.[1a,2a–d] Furthermore, till now there is no recent review published since more than 3 decades, which could cover the synthetic aspects of the organic carbamates. Since last 2–3 decades, much progress on the synthesis of organic carbamates has been realised, employing various kinds of cheap and safe alternatives, such as various forms of carbon dioxide, organic

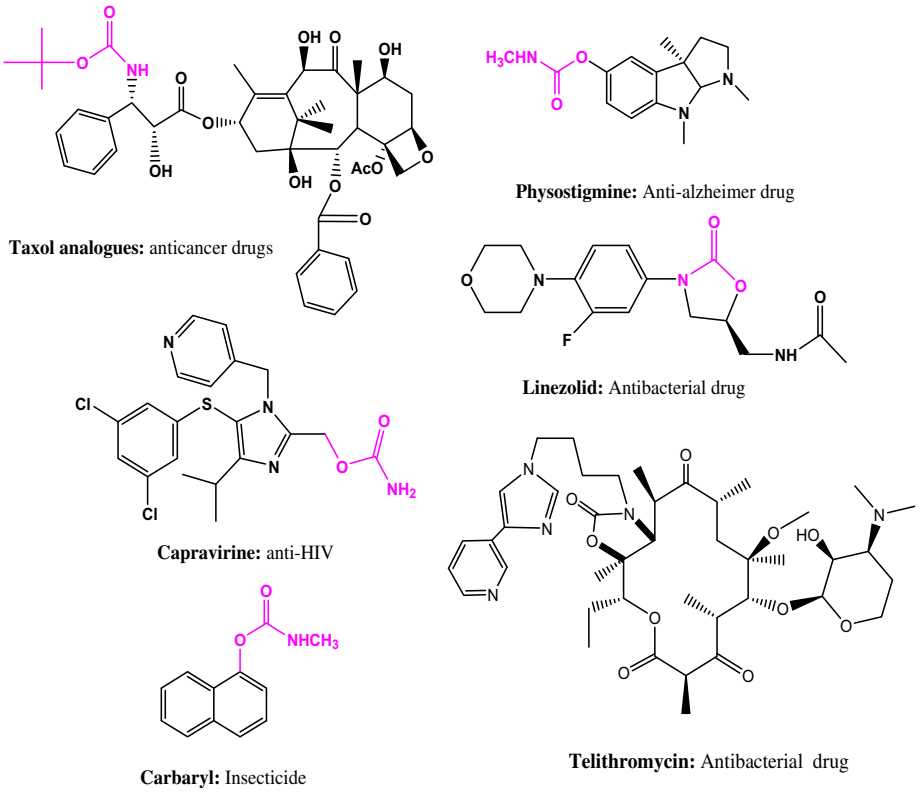

Fig. 1. Biologically active drug molecules bearing carbamate linkage.