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Importance of Organic Chemistry in Pharmaceutical Drug Development

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ABSTRACT: Organic chemistry plays a fundamental and indispensable role in pharmaceutical drug development. As the branch of chemistry that focuses on the structure, properties, reactions, and synthesis of carbon-containing compounds, organic chemistry provides the essential scientific foundation for the discovery, design, and production of modern medicines. Most therapeutic drugs used today are organic molecules, meaning they are composed primarily of carbon atoms along with elements such as hydrogen, oxygen, nitrogen, sulfur, and halogens. Understanding how these atoms combine to form complex molecular structures is crucial for developing safe, effective, and targeted pharmaceutical treatments. Through the principles and techniques of organic chemistry, scientists can design new molecules that interact with biological systems in specific ways, enabling the treatment and prevention of a wide range of diseases.

KEYWORDS: Organic Chemistry, Pharmaceutical Drug Development, Medicinal.

I. INTRODUCTION

Biosynthetic studies of PGs have shown the presence of y-linolenic acid 19 and arachidonic acid 18 in both lower flora and fauna as well as higher mammals.19 Protozoa, algae, mosses, and ferns have all been proven to have significant amounts of arachidonic acid 18; fungi, protozoa, the oil seeds of hops and hemp, boraginaceae, and lilicceae have all been shown to contain y-linolenic acid. The organism Euglena gracilis can manufacture polyenoic acids, which are unique to higher plants and animals.

Euglena gracilis cells create many saturated fatty acids, most notably a-linolenic acid 20, during photosynthesis. Cells that develop in the dark do not produce this acid. Arachidonic acid is produced in high quantities when there is not enough light in the growth medium. Phospholipids, the building blocks of membranes, are known to include such unsaturated acids from the cell. Normal fatty acid synthesis results in the formation of these compounds, which are then dehydrogenated. They have a function in membranes and may also serve as a source of energy; they are found in the oils of the seeds of higher plants.

They provide the seed with nutrients. The term "membrane" is usually used in conjunction with the function of these unsaturated fatty acids. The unique physical characteristics of a membrane are thought to be influenced by the chain length and degree of unsaturation of the fatty acid present in the membrane. Unsaturated fatty acids may have various purposes in the plant, although this is not understood at this time. There is no known mechanism in which they participate.

While linoleic and arachidonic acids are considered necessary for mammals, there is evidence that some fatty acids are also required for the survival of lesser creatures. with example, a-linolenate was shown to be an essential nutrient in the cabbage interlooper I 5 (Trichoplusia ni) that could not be substituted with linoleate. It's likely that a-linolenate doesn't accomplish anything by itself but does so after being transformed into a different molecule.20 Because of the physical qualities they confer on membranes, polyunsaturated fatty acids are crucial to the structural integrity of all living organisms.

Both the widespread presence of PGs in mammals (19) and the comparative characteristics of PG production in various species (20) have been documented by van Drop et al. Prostaglandins have been discovered in the gastrointestinal tracts of the frog (20), the shark Triakis scyllia (2i), and the mussel and lobster (PGs Synthesis). The testes and sperm of

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Teleosts have also been shown to contain PGs. Large quantities of prostaglandins, namely prostaglandins A2 and E2, have also been recovered from very simple organisms like the marine soft coral Plexaura homomalla (Esper). Mammals have PGs in trace amounts throughout their bodies, including in the iris of the eye, the brain, the thymus, the bronchial tubes, the pulmonary alveoli, the seminal plasma, the seminal fluid, the ovary, and the uterus. Intestine, adrenal, stomach, kidney, nervous tissue, etc. PGs were detected after suitable stimulation. However, a human adult only produces around 1-2 mg of PG in a 24-hour period.

Due to their wide variety of biological effects, prostaglandins (PGs) constitute a promising therapeutic target. The reproductive system (in both sexes) and many other organs are not the only ones affected by PGs. Prostaglandin analogues (prostanoids) show promise as therapeutics due to their wide range of biological activities. In fact, PG analogues are now utilized to treat a variety of medical issues, including ulcers, hypertension, and others. Several possible processes for prostaglandin production were researched in the 1960s and 1970s, not long after the fundamental structure of prostaglandins was identified. However, asymmetrical syntheses provide their own difficulties. There has been a lot of effort put into this, but it still needs further investigation. Pharmaceutical firms would benefit greatly from the discovery of a potent, asymmetric route to prostaglandins [2].

II. BIOSYNTHESIS OF PROSTAGLANDINS

The manufacture of 9 prostaglandins is controlled by the activity of phospholipase A2 and cyclooxygenase on phospholipids (PGs) in cell membranes. Arachidonic acid is first converted to prostaglandin H2 (PGH2) by the cyclooxygenase (COX) enzymes, and then to further PGs by the numerous PG synthases. The enzyme PGDH converts bioactive PGs into inactive ketometabolites from ketogenic PGs. All of the PGs—PGD2, PGF2, PGI2, TXA2, and PGE2—share PG receptors—DP, FP, IP, TP, and EP. PGE2 receptors are divided into four classes (EP1-4). They are only functional when cAMP levels are altered (DP, IP, EP2, EP4) or raised (EP1, EP2, EP3) or lowered (EP4, EP5). The production of a prostaglandin involves three main processes. Arachidonic acid (AA) is initially unbound from the sn-2 position of membrane phospholipids (figure 1.19). This means that low cellular levels of arachidonic acid (AA) may serve to suppress the production of prostaglandins. Arachidonic acid (AA) may not only play a function in prostaglandin formation, but also as a signaling molecule that regulates AA release and prostaglandin production [5].

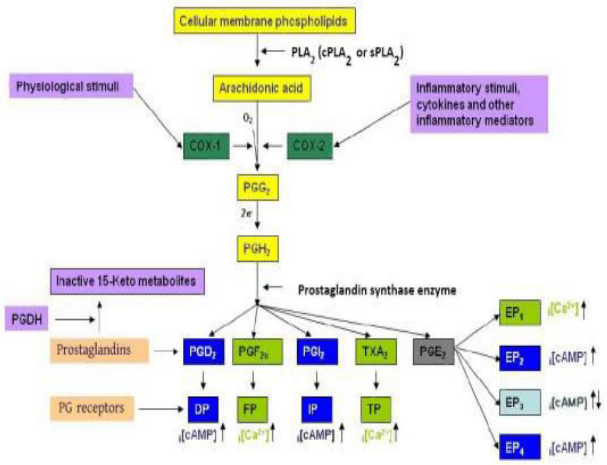

Fig.-Methods of Prostaglandin Synthesis

II. LITERATURE REVIEW

Lei Xu (2022) [2] Methyl furylacrylates are a new functionalized furanoxonium ion precursor that has been used to generate Aza-Piancatelli rearrangement-triggered cascade reactions for the efficient and versatile production of cyclopenta[b]pyrrolidinone derivatives. After lactamization, a unique retro-aza-Piancatelli rearrangement took place, changing the minor cis-fused multifunctionalized cyclopentenone from the main trans-fused cyclopentenone.

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van Slagmaat, Christian A. M. R. (2021) [3] After the recent success in synthesizing 4-hydroxycyclopent-2-enone (3), scientists have been more interested in cyclopentane-1,3-diol (4b) as a possible building block for polymers and fuels. More 4b is generated during the hydrogenation process under more concentrated circumstances because cyclopentane-1,3-dione (4), a constitutional isomer of 3, has more chemical stability. This study used a commercial Ru/C catalyst to investigate the hydrogenation of four into fourb on a laboratory bench. The pace of reaction and the prevention of undesired dehydration of 4 were demonstrated to be significantly affected by temperature, H2-pressure, and solvent choice. There are a number of natural processes that result in a 7:3 cis:trans ratio for 4b. But at higher reaction temperatures, 4b epimerizes to produce more trans products. The thermodynamics of this effect were also investigated and explained using DFT. 4b yielded 78% under optimal conditions, and the versatility of this catalytic method was shown by the fact that it could be scaled up eight times (40 g) and used with a variety of 1,3-diones as substrates.

Zhou Weiping (2021) [4] This C4-quaternary stereocenter is prepared by the catalyzed cationic gold(I) [3,3]-sigmatropic [3,3]-sulfonium rearrangement. From basic vinyl sulfoxides and propargyl silane (26 occurrences), many compounds were produced with moderate to acceptable yields and good enantiomeric excesses. Five natural sesquiterpenoids, including enokipodins A and B, hitoyopodin A, lagopodin A, and isocuparene-3,4-diol, were successfully synthesized using this straightforward approach.

Shuling Yu (2021) [5] used acrylic acids, formaldehyde, and malonates in a three-component rhodium-catalyzed cyclopentenone synthesis. Exploratory research revealed a straightforward method to 5-alkylate as-prepared cyclopentenones by treating various alkyl halides with a Na2CO3/MeOH solution. The multisubstituted cyclopentenones were made using a multicomponent technique that included the use of excess formaldehyde and malonate.

Xiao Wang (2021) [6] The eight stereogenic centers in the pentacyclic sesterterpene retigeranic acid A make it special. We have discovered a straightforward method for penetrating the inside of (-)-retigeranic acid A. It has a well regulated stereochemistry thanks to its six chiral and three quaternary carbon atoms. The triquinane subunit was transported by one IMPKR, which generated rings D and E; the other IMPKR built rings A and B to diastereoselectively install a quaternary C6a center along this pathway.

Denis D. Borisov. (2021) [7] A diastereoselective technique was developed by reacting -styrylmalonates with furfural derivatives in the presence of GaCl3 to produce trisubstituted cyclopentenones containing a 1,4-diketone group. Substrates generated by the process were subjected to several other chemical reactions, and the ensuing patterns were studied. The formation of substituted (4-oxo-2-arylcyclopent-2-enyl)malonates is a possible outcome of this reaction.

Jin Cao, (2021)[8] Making cyclopentenones is simple using the Nazarov electrocyclization method. Despite its recent popularity, this reaction has limited applications in synthetic chemistry because of the techniques used to control the position of the double bond, which in turn restricts the range of potential substituent patterns. Lewis acid and chiral Brnsted acid have been shown to catalyze silicon-directed Nazarov reactions with high selectivity for enantiomeric species. As far as we're aware, this is the only known catalytic enantioselective technique that can produce chiral cyclopentenones. By stabilizing the -carbocation in the intermediate, the silicon group in the dienone substrate dictated where the double bond would be in the end product. Based on the results of the mechanistic studies, it was determined that the dienone substrate was activated synergistically.

III. MATERIAL AND METHODS

The stereochemistry of the hydroxyl group at position 6 of the acetylenic ester is crucial to our synthesis. This logical grouping serves two purposes. It may lead to the formation of new stereo centers at atoms C-8 and C-12 by directing the reduction of the double bond in molecule 5. (2) Through sigmatropic shift, it offers latent capability for the C-15 stereocenter. The biological action of PG relies on the integrity of its C-15 core stereochemistry. In the past, this intermediate was obtained through asymmetric addition of ethyl propiolate (7) to trans-2-octenal (8) using taddol, reduction of the corresponding ketone with Alpine borane, or by attaching a chiral group to the hydroxyl moiety of the racemic intermediate (then separating the diastereomers). However, none of these approaches produced an intermediate with satisfactory yield and ee.

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IV. SAMPLE DESIGN

Medical records of 3696 patients diagnosed with glaucoma and treated at Izmir Bozyaka Training and Research Hospital were analyzed retrospectively. The glaucoma group consisted of 73 patients and their eyes, whereas the control group included 75 people and their eyes. Patients with newly diagnosed ocular hypertension or primary open angle glaucoma were given either latanoprost 0.005% (Xalatan, Pharmacia Corp, Peapack, NJ; 27 eyes of 27 patients) or bimatoprost 0.03% (Lumigan, Allergan, Irvine, CA; 24 eyes of 24 patients) or travoprost 0.004% (Travatan, Alcon Laboratories, Inc., San Diego; 27 eyes of The topical PG medicine was applied once daily to all patients. Patients were not eligible to participate if they had retinal vascular or macular problems, inflammatory illnesses including uveitis, or were currently using steroid or non-steroidal anti-inflammatory medicines. Participants with corneal illness or a break-up time of less than 10 seconds were not included in the research, and all IOP readings were obtained by the same, highly experienced examiner. Consistent adherence to the Helsinki Declaration's tenets was maintained.

The second kind of bond involves molecules that share a cyclopentane core but have different structures attached to them. This molecule has had an extra chain attached to it (Scheme 2). The three component coupling process (Scheme 3) is a third method for producing prostaglandins. Here's a case study of each strategy. A Corey's lactone analogue was synthesized by Augustyns et al. in 2005 (Scheme 4). 5 A Diels-Alder reaction was performed on 1.12 and 1.13, a radical-driven skeletal translocation yielded 1.15, and isomerization of 1.15 yielded 1.16. Bromohydrin was synthesized by first decarboxylmethylating lactone 1.17 using lithium chloride, and then acetylating the resultant compound. The 1.19 tendency for side chain attachment was associated with extreme debromination of the core structure. Togashi et al. 6 synthesized alkyne 1.21.1 from 1, 1-dibromo alkene (1.20) by adding an aldehyde chain. Swern oxidized the hydroxyl group, producing a ketone, and the resulting yield was 1.22. K-selectride was used in a stereoselective reduction of the carbonyl group of the ketone to produce alcohol 1.23. The alkyne had to be reduced and the hydroxyl group acylated to get to 1.24, which was the starting material for the Pd-catalyzed cyclization that formed the functionalized core with the 87:13 R:S stereocenter (Scheme 5). Scheme 6 depicts a three-component, one-pot coupling method for prostaglandin production. Cyclopentenone coordinates to aluminum, maintaining the enone's position, and so facilitating the successive Michael-aldol reactions of dibenzyl methylmalonate and methyl 7-oxoheptanoate. In the presence of a chiral aluminum catalyst, a reaction between racemic cyclopentenone and an aldehyde yields 75% product yield and 97% ee.

IV. DATA ANALYSIS

Prostaglandins (PGs) are significant in medicine due to the variety of biological roles they play. The reproductive (in both sexes) and immunological systems, as well as the digestive, neurological, cardiovascular, and endocrine systems, may all be affected by PGs.1 Because of their diverse biological action, prostaglandin analogs (prostanoids) hold promise as potential therapeutic agents. In fact, PG analogs are now being utilized to treat a wide range of medical issues, such as ulcers, hypertension, and others.

Once the structure of prostaglandins (PGs) was understood, researchers in the 1960s and 1970s investigated a wide variety of prostaglandin biosynthesis pathways.2,3 However, getting to the point of asymmetric PG synthesis still presents significant difficulties. There has been a lot of experimentation, but we still have a lot to learn. The discovery of a strong, asymmetric pathway to prostaglandins by pharmaceutical corporations will be a major boon to the development of prostanoids.

The primary goal of our improved PG synthesis is to get the intermediate 6 in high yield and remarkable stereochemical purity in order to cyclize and analyze the stereospecificity of the 5 to 4 reduction. We are now exploring many routes for manufacturing intermediate 6 or a similar acetylenic acid derivative 10 (Figure 4.1). The two most common approaches are known as diastereoisomer separation and direct asymmetric synthesis, respectively. Many reactions are stable in the presence of water and air, and stereoisomer separation (using techniques like ordinary chromatography) makes this possible. The most glaring issue is that even under ideal conditions (Scheme 6), only half of the desired enantiomer would be produced. It is worth investigating because a little quantity of the intermediate may be utilized to demonstrate stereo selectivity in the conjugate reduction of 5 (Scheme 4). A chiral acetylenic amide intermediate and its diastereomers are under investigation, as is the selective deacylation of this intermediate with the commercially available enzyme Novozym 435.

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Acetic anhydride and pyridine were used to acylate intermediate 6 to form 13. The acylated intermediate 13 was then deacylated by the enzyme. Aqueous buffer was employed as the solvent in the initiation conditions. Since intermediate 13 is insoluble in water, there was little chance of a reaction between the enzyme (on solid beads moving freely in the solution) and the substrate. We found reports of deacylation in organic medium as a means of connecting substrate and enzyme.15 The substrate was dissolved in the reaction mixture and made excellent contact with the enzyme, but no reaction occurred. Since the other substances cited included just a single ester function, it's probable that the ester group is interfering with the enzyme's normal functioning. While alternative possibilities were considered, it may be beneficial to first resolve 11 and then add the ester function.

The low harvest might have many potential reasons. So, we decided to put each potential factor to the test one by one. Since we suspected that the copper bromide complex could be contaminated, we set out to make our own and purify it following the procedure outlined here. We settled on buying a newly produced, commercially accessible, colorless, and seemingly pure copper bromide-dimethylsulfide chemical. The response still had low yields, however.

With high-quality copper bromide and faith in the integrity of our reaction solvents, we set out to examine the first stage, the sonication of (1-ethoxycyclopropyloxy) trimethylsilane to produce zinc homoenolate 29. The NMR study of 29 is possible since it is stable in deuterochloroform solution. Sonication of (1-ethoxycyclopropyloxy) trimethylsilane in dry ether with zinc chloride. NMR testing, however, showed that the expected homoenolate 29 never formed. 34 According to Dr. Crimmins, enough homoenolate was generated in the first few rounds of the reaction using commercial zinc chloride solutions (29). He went on to explain that whereas commercial zinc chloride had failed in other processes, lab-made zinc chloride had succeeded. We just bought 1 M zinc chloride in diethylether from a commercial provider for use in our lab. By fusing solid zinc chloride under vacuum and sonicating the resultant solid with a sufficient quantity of dry diethylether, a chemically equivalent solution may be made in the lab. It is possible to utilize a fresh zinc chloride solution in ether that has been purchased from somewhere else. Both approaches are now undergoing laboratory testing.

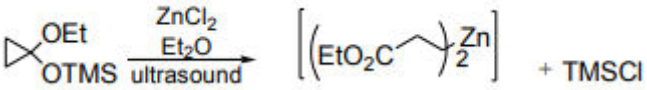

Figure - Formation of Zinc Homoenolate

V. RESULT AND DISCUSSION

Every solvent was either distilled, received from a solvent still, or of HPLC grade, unless otherwise specified. Flash chromatography using either regular or high-quality Rf 100 A 75-200 um spherical silica gel was used for all purifications. Except for the ozonolysis tests, all glassware was flame dried in an environment of nitrogen. All melting points were established by starting with the crystal's melting point.

For their nuclear magnetic resonance (NMR) investigations, scientists employed the following spectrometers: A Bruker AV-4 with BBI with zgradient, QNP (1H, 19F, 13C, 31P) probes was used to analyze 400 MHz and 100 MHz labeled samples, while a Bruker DPX-250 with the same probes was used to analyze 250 MHz and 62.5 MHz labeled samples. All NMR spectra were analyzed using MestreNova 7.19185100.215465, 2011-2015 Mestrelab Research S.L. and Bruker TopSpinTM. All FT-IR measurements were taken using a Bruker Tensor 27 FT-IR equipped with DTGS detectors, a mid-IR source (4000-400 cm-1), KBr beam splitters, and OPUS data gathering software. The FT-IR data was analyzed using Excel 2015 and Essential FTIE v3.00.031.

The CP 3800 Varian gas chromatograph with the 1900-volt electron multiplier and the ion trap detector was used for all mass spectrometric analyses. All of the samples were loaded automatically onto a DB5-MS Agilent J & W column filled with 5% phenol methyl siloxane via a splitless injector. A temperature of 250 degrees Celsius was achieved in the injector. The rate of heat production was 15 degrees Celsius per minute. Masses were discovered between 40 and 650 m/z. Using the System Control Varian Saturn 2200 software, all GCMS data was evaluated. The Time-of-Flight/Quantum-Tomographic Mass Spectrometer was used for every ESI analysis. A dual ESI TOF was used as the ion source. There was a wide range in weight, from 110 to 3000 grams. 62 gas had a temperature of 325 degrees

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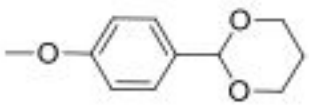
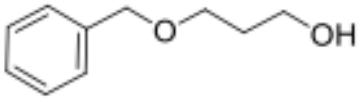
Fahrenheit. There was a gas flow of 8 liters per minute. The nebulizer's pressure was set at 20 psi. The solvent ratios utilized were: 10% water, 0.1% formic acid; 90% acetonitrile, 0.1% formic acid.

In a 500 mL round bottom flask, we combined 2 phenyl-1, 3-dioxane, 20.80 g of benzaldehyde, 14.90 g of 1,3-propanediol, 37 mg of p-toluenesulfonic acid monohydrate, 1.94 mmol, and 200 mL of toluene. The Dean-Stark trap was used to remove water after 15 hours of refluxing. After being rinsed three times with water, the mixture was extracted using diethyl ether. After being washed using a filter, the organic compounds were dried with MgSO4 and their solvent was extracted. The end result was a crystalline white material. NMR spectra may detect trace levels of unreacted benzaldehyde. After purifying 28.1 g of product, a yield of 87% was recorded.



Ingredients included 2-(4-Methoxyphenyl)-1,3-dioxane, 5-Methylbenzaldehyde, 1,3-propanediol, p-toluenesulfonic acid monohydrate, and toluene in a Dean-Stark trap-fitted 250 mL round bottom flask. After 15 hours of refluxing, the reaction was complete. Diethyl ether was used for extraction, and the mixture was rinsed in water. White crystals (6.0 g, 84%) with a melting point of 40.0 oC were obtained after the solvent was evaporated, the organic components were dried with MgSO4, and the crystals were filtered. Occasionally, unreacted 4-methoxybenzaldehyde, ethyl acetate, and hexanes may be detected in NMR spectra.



VI. CONCLUSION

Prostaglandins (PGs) are a group of naturally occurring substances that have a wide range of effects on living organisms. All of the natural PGS are derived from prostanoic acid, an unsaturated hydroxylated fatty acid (Figure 1). Their potency and activity in many seemingly unrelated biological systems have piqued the curiosity of scientists from a wide range of fields, but their specific physiological significance remains unclear. In fact, PG are linked to a growing list of physiological systems * and present in the majority of mammalian tissues. When administered to a human uterus, human sperm may cause powerful contractions or relaxations, as shown by Kurzrok and Lieb in 1930. A vasodepressor agent and a stimulating factor of muscles were separately discovered in human seminal plasma and sheep vesicular glands 3 by Von Euler and Goldblatt a few years later. Indicating that an acidic lipid-soluble substance was responsible for the biological action, von Euler coined the term "prostaglandin"4. It took around 30 years from the first discovery of PG's biological action to the subsequent clarification of the structure of two of them. The technological problems previously encountered in the isolation of natural PG are only one of several reasons why this field lay dormant for so long. Furthermore, PG research was forgotten because to the enormous advancements in antibiotics and hormone treatment during the previous 30 years. From vesicular seminal preparations of sheep, Bergstrom and Sjovall identified the crystalline PGEi and PGFia in 1957. Soon after, Bergstrom, Sjovall, and Samuelsson were able to separate the mixture into its component parts and identify 13 unique chemicals. After PGS were demonstrated to be biologically active substances via isolating and structurally characterizing them, the field began to flourish.

REFERENCES

1. Antosova M, et al. Nitric oxide—important messenger in human body. Open J Mol Integr Physiol. 2012;02(03):98. doi: 10.4236/ojmip.2012.23014.
2. Araie M, et al. Evaluation of the effect of latanoprostene bunod ophthalmic solution, 0.024% in lowering intraocular pressure over 24 h in healthy Japanese subjects. Adv Ther. 2015;32(11):1128–1139. doi: 10.1007/s12325-015-0260-y.
3. Ashpole NE, Overby DR, Ethier CR, Stamer WD. Shear stress-triggered nitric oxide release from Schlemm's canal cells. Invest Ophthalmol Vis Sci. 2014 Nov 13;55(12):8067-76. doi: 10.1167/iovs.14-14722. PMID: 25395486;

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International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

PMCID: PMC4266075.

4. Augustyns, B. M., N.; Marko, I. Skeletal Rearrangements of Bicyclo[2.2.2]Lactones: A Short and Efficient Route Towards Corey's Lactone. Tetrahedron. Lett. 2005, 46. 3895

5. B.J.R. Whittle, Role of prostaglandins in the defense of the gastric mucosa, Brain Research Bulletin, Volume 5, Supplement 1, 1980, Pages 7-14

6. Baars, H.; Classen, M.J.; Aggarwal, V.K. Synthesis of Alfaprostol and PGF2α Through 1,4-Addition of an Alkyne to an Enal Intermediate as the Key Step. Org. Lett. 2017, 19, 6008–6011.

7. Balke, K.; Bäumgen, M.; Bornscheuer, U.T. Controlling the Regioselectivity of Baeyer-Villiger Monooxygenases by Mutation of Active Site Residues. ChemBioChem 2017, 18, 1627–1638.

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