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Review

Sustainable Biosynthesis of Esterase Enzymes of Desired Characteristics of Catalysis for Pharmaceutical and Food Industry Employing Specific Strains of Microorganisms

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Abstract: Reactions catalysed by sustainably produced enzymes can contribute to the bioeconomy supporting several industries. Low-value compounds can be transformed into added-value products or high-resolution chemicals could be prepared in reactions catalysed by biocatalyst esterase enzymes. These enzymes can be synthesised by purposely isolated or genetically modified strains of microorganisms. Enzymes belonging to the hydrolase family catalyse the formation and hydrolysis of ester bonds to produce the desired esterified molecule. The synthesis of homo-chiral compounds can be accomplished either by chemical or biocatalytic processes, the latter being preferred with the use of microbial esterases. For varied applications, esterases with high stability and retained activity at lower and higher temperatures have been produced with strains isolated from extreme environments. For sustainable production of enzymes, higher productivity has been achieved by employing fast-growing *Escherichia coli* after incorporating plasmids of required characteristics from specific isolates. This is a review of the isolated and engineered strains used in the biosynthesis of esterase of the desired property, with the objective of a sustainable supply of enzymes, to produce products of industrial importance contributing to the economy.

Keywords: hydrolase; esterase; enzyme; biocatalyst; biotransformation; microorganism

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1. Introduction

Enzymes produced employing the selected strains of microorganisms have been generally accepted as superior biocatalysts to perform effectively and economically in the biotransformation of compounds in comparison to with the use of chemical catalysts. Sustainable recovery of compounds from renewable substrates for industrial applications is one of the pillars of the bioeconomy. Enzymes have been widely studied for their biochemistry, specific reactivity, and contribution to biochemistry and biological systems. Enzymes from microbial sources have been used for their important contribution as biocatalysts to synthesise added-value metabolites, as well as being used as an important tool in the area of diagnostics and therapeutics to improve human health [1]. The processes could be catalysed by biocatalysts as actively growing microbial cells, either in the form of freely suspended in the reaction medium or in immobilised form for their reuse. Usually, the preferred option for the production of specialty products is the use of pure biocatalysts preferably in form of high specific activity enzymes, biosynthesised by selected microbial strains. Such processes are called microbial transformations (using microbial cells), biotransformation (using appropriate enzymes derived from microbial cultures), bioconversion, and biodegradation (by whole microbial cells or enzymes synthesised by them) [2].

In the context of sustainability and clean production technologies, microbial enzymes are an economical alternative for the achievement of biochemical reactions and transformations. Enzymes are non-toxic, biodegradable, and efficient selective biocatalysts with catalytic activities superior to organic catalysts in many cases. Enzymes can be synthesised

in environment-friendly production systems, compared to the synthesis of chemical catalysts [2–4]. High interest has been shown in enzymes prepared from microbial strains surviving under extreme environments, similar to the conditions used for the operation of industrial processes [3,4].

Among extremophiles, microorganisms living in cold or hot environments have become a source for the production of enzymes with specific characteristics, which could be active in conditions of lower or higher temperatures, as they would be needed to catalyse different biotransformation reactions of varied temperature requirements [5]. The use of enzymes at low temperatures has economical potential for industrial processes through energy savings by lowering the reaction temperature without the deactivation of enzyme activity. Reactions operated at lower temperatures using cold-active enzymes also stop unwanted chemical reactions, which could otherwise happen at higher temperatures. Their structural thermolability is of special advantage in the food industry for eliminating the use of chemical-based inactivation of products [2,3]. Cold-active enzymes have been prepared from psychrophiles and psychrotolerant microorganisms, whereas, the high-temperature active and thermostable enzymes can be synthesised from thermophilic microbial isolates.

1.1. Hydrolase Enzymes

A process of transformation is usually the conversion of one compound (acting as a substrate) to another compound which is required as an end-product), where reaction always requires a suitable catalyst to start and complete the process. Hydrolase enzymes act as biocatalysts to perform reactions in a faster way [3]. Enzymes have been manipulated to improve their quality of biotransformation and bioconversion to speed up the biochemical reactions for their suitability and sustainability for industrial applications [4]. If a reaction can be completed using intercellular or extracellular enzymes synthesised by specific microbes, the process of biotransformation would be economical for the large-scale synthesis of specialty molecules of industrial importance, such as flavours and aromas for the food industry and optically pure compounds for the pharmaceutical industry [4,5]. Researchers have designed effective cell-factories, incorporating enzymes as well as actively growing whole microbial cells, together in one biocatalyst entity [6–8]. Such cell-factories have been employed to perform multi-step (usually 2 to 3) processes for the synthesis of products by biotransformation and at the same time utilizing industrial by-products, towards a contribution to bioeconomy [9,10].

Hydrolase enzymes are gaining attention because of their wider utilisation as biocatalysts. Esterases and lipases are two major classes of hydrolases, but both share certain common features, for example, the racemic resolution of compounds, however, they also have their own unique properties [11,12]. The three-dimensional structure of both enzymes shows a characteristic-hydrolase fold [13,14].

1.2. Catalytic Process of Esterase Enzyme

Esterase catalyses the breakdown and formation of ester bonds. The enzyme commission number assigned to esterase is E.C 3.1.1.x, where x depends on the substrate where the esterase is acting [13]. The primary catalysis activity of esterases is to perform the process of hydrolysis

$$\text{R1-COO-R}_2 + \text{H}_2\text{O} \rightarrow \text{R1-COOH} + \text{R2-OH}$$

R represents a hydrocarbon moiety in all reactions presented here.

There are other types of ester-forming reactions catalyzed by esterases, each reaction is performed under specific conditions [1,14–17]:

$$\text{Esterification: R1-COOH} + \text{R2-OH} \rightarrow \text{R1-COO-R2} + \text{H}_2\text{O}$$

$$\text{Transesterification: R1-COO-R2} + \text{R3-COO-R4} \rightarrow \text{R1-COO-R4} + \text{R3-COO-R2}$$

$$\text{Acidolysis: R1-COO-R2} + \text{R3-COOH} \rightarrow \text{R3-COO-R2} + \text{R1-COOH}$$

Alcoholysis: R1-COO-R2 + R3-OH → R1-COO-R3 + R2-OH

Esterases with multifunctional properties such as broad substrate specificity and regiospecificity have the potential for their uses in the hydrolysis and synthesis of ester compounds of importance in pharmaceutical, food, biochemical, and biotechnology industries.

2. Importance of Esterase in Bioeconomy

Esterase enzyme can be specifically used to produce optically active pure products for pharmaceutical industries. Esterases are used as biocatalysts in esterification and transesterification reactions to separate enantiomers from a racemic mixture, like in the resolution of (*R*,*S*)-ibuprofen methyl ester; in hydrolysis reactions to split esters into acid and alcohol with a neutral pH solvent water; to obtain yields of (*S*)-naproxen, a non-steroidal anti-inflammatory drug, with high optical purity achieved from the hydrolysis of (*R*,*S*)-naproxen methyl ester. In addition to naproxen, various other 2-aryl propionic acids are produced with high enantioselectivity to obtain pure compounds for pharmaceutical applications [13–17].

The potential of esterase in biotransformation has increased in the last few decades due to the requirement of optically pure compounds in several industries. It is known that in many cases, only one stereoisomer of a compound is required for its efficacy, and the other isomer is either inactive or exhibits considerably reduced activity, or in some cases, it might even cause undesirable side effects. Therefore, it is important to synthesise active forms of compounds through the process of transformation. Esterases are involved as effective catalysts in the synthesis of ester bonds via the production of homochiral compounds to avoid the presence of undesirable stereoisomers, for example, the synthesis of captopril [15]. Economically, the synthesis of homochiral compounds with high selectivity can be achieved in a biocatalytic process using esterase enzymes derived from microbes, for example, the production of ketoprofen [16].

The advantage of using stereo-selective esterases becomes the favourable choice over the chemical synthesis of pharmaceutical products. As an advantage, the bioprocesses can be easily manipulated to be performed at ambient conditions of temperature and pH using enzymes of specific characteristics. For example, captopril, an orally active antihypertensive agent, has a unique inhibitory action on the angiotensin-converting enzyme (ACE) of the renin–angiotensin system [15]. Its potency as an inhibitor of ACE depends on the configuration of its side chain [17], which with *S*-configuration is about 100× more active than its corresponding *R*-enantiomer. Therefore, this active form (*S*-ß-acetylthio-2-methyl propionic acid) used in captopril synthesis was prepared in an esterase-catalysed transformation of its *RS*-form [15,18].

The preferred substrates for esterase are simple esters and short-chain triglycerides, and esterases do not require interfacial activation. Esterases can catalyse esterification, inter-esterification, and trans-esterification with very effective chemo-, regio- and enantioselectivity [19–21]. For these characteristics, esterases can be applied to synthesise optically pure compounds for food and paper industry, in the degradation of plastics and pesticides [22]. Esterases hydrolyze short-chain carboxylic acids (≤C 12) and do not require cofactors and this property makes them attractive biocatalysts [23]. Though esterases are stable in a wide range of pH and temperature, some esterases have low thermal stability. A desirable property is their positive activity required in a reaction medium containing organic solvents. Esterases, due to their properties of stability in organic solvents, regioselectivity, and stereo-specificity, have established their use as suitable biocatalysts for biotransformation processes [22]. Due to specific characteristics, a different application of esterases has been reported for the biodegradation of dental composites, incorporating the shared influence of two forms of biocatalyst, cholesterol-esterase and pseudocholine-esterase [24].

Sustainable Sources of Esterases

Research has been focused on the production of esterases from microbial sources so that they can be prepared for larger supplies with increasing demand in several industries [21,22,24]. Esterase produced from microbial sources is an attractive option because the cost to grow microbial culture and their maintenance is smaller, and they are easy to be manipulated or modified genetically to achieve improved enzyme yield with higher specific activity. Specific strains of bacteria, fungi, and actinomycetes have been studied to produce esterase—either constitutively or as an inducible enzyme, and for this purpose, specific strains have been isolated from samples collected from relevant sources [25]. The process of isolation and screening of esterase producers is usually performed by the use of chromophoric substrates such as p-nitrophenyl esters, and by cultivation of isolates on tributyrin-supplemented agar medium culture plates. The isolated strains capable of producing active esterases are identified by the appearance of clear zones around their colonies on culture plates containing dispersed water-insoluble triglycerides. Using such enrichment techniques, esterase producer strains have been isolated from cheese surfaces [26], oil-contaminated areas of city garbage [19,20], marine squids [27], and various other sources. The isolated strains after their identification have been specifically used for the synthesis of different types of esterase, as summarised in Table 1.

Table 1. Selected microbial strains for esterase production.

S. No.	Enzyme	Producer Microbial-Strain	References
1	Pyrethroid-hydrolysing enzyme	Recombinant *E. coli*	Fan et al., 2012 [28]
2	Acetyl xylan esterase	*Bacillus pumilis*	Degrassi et al., 1998 [29]
3	Carboxyl-esterase I and II	*Bacillus subtilis* NRRL 365	Meghji et al., 1990 [30]
4	Pyrethroid-hydrolysing esterase	Metagenome	Li et al., 2008 [31]
5	Acetylesterase	*Aspergillus awamori*	Koseki et al., 1997 [32]
6	Esterases with hydrolytic and synthetic activities	Bacterial isolates from cheese surfaces	Gandolfi et al.,2000 [26]
7	Cephalosporin esterase	*Rhodosporidium toruloides*	Politino et al., 1997 [33]
8	Acetyl esterase	*Bacillus subtilis*	Higerd and Spizizen, 1973 [34]
9	Acetyl esterase	Mutants of *Bacillus subtilis*	Higerd, 1977 [35]
10	Acetyl xylan esterase I and II	*Thermoanaero-bacterium* sp. Strain JW/SL-YS485	Shao and Wiegel, 1995 [36]
11	Esterase	*Pseudomonas fluorescens*	Khalameyzer et al., 1999 [37]
12	Esterase	*E. coli* EPI300 TM-T1^{R}	Kim et al., 2005 [38]
13	Esterase	*Anoxybacillus gonensis* A4	Faiz et al., 2007 [14]
14	Esterase	*Pseudoalteromonas haloplanktis*	Aurilia et al., 2009 [39]
15	Esterase	*Halobacillus* sp. strain LY5	Li et al., 2012 [40]
16	Esterase	*Monascus* species	Chen et al., 2011 [41]
17	Feruloyl esterase	*Aureobasidium pullulans*	Rumbold et al., 2003 [42]
18	Esterase	*Vibrio fischeri*	Ranjitha et al., 2009 [27]
19	Esterase	*Bacillus subtilis* (RRL 1789)	Kaiser et al., 2006 [43]
20	Esterase	*Bacillus* sp. DVL2	Kumar et. al., 2012 [19]
21	Esterase	*Bacillus* sp. DVL43	Kumar et. al., 2012 [20]
22	Esterase	*Streptomyces lividans* 66	von der Haar and Schrempf, 1995 [44]
23	Esterase	*Micropolyspora faeni*	Bannerman and Nicolet, 1976 [45]

Table 1. *Cont.*

S. No.	Enzyme	Producer Microbial-Strain	References
24	Esterase (PmEst)	*Petrotoga mobilis*	Lopes et al., 2016 [46]
25	Esterase producing banana flavour in reaction	*Bacillus licheniformis S-86*	Sebastián et al., 2009 [47]
26	Novel Esterase	From the DNA Library of *Acinetobacter hemolyticus*	Dong et al., 2017 [48]
27	Novel esterase	From a marine mud metagenomic library	Gao et al., 2016 [49]
28	Esterase for chiral secondary alcohols	*Pseudomonas stutzeri*	Lehman et al., 2014 [50]

Studies have been performed for the biosynthesis, purification, and characterisation of esterases of specific characteristics employing selected microorganisms such as Bacillus [51], Pseudomonas [52], and lactobacillus, which are capable of biotransformation of a variety of industrially important compounds [53]. Despite the existence of esterases from various sources (Table 1), researchers are focusing to achieve competitive yields in economical processes. For economical and sustainable yields of the enzyme, the process can be manipulated by cultural and nutritional factors [54] in economical processes of solid-state fermentation using residual substrates generated in agriculture. These residues as by-products are cheaper to buy or sometimes are even available free of cost. Two such substrates, wheat bran and wheat straw, were used for the economical enzyme production by specifically selected *Sporotrichum thermophile* in the solid-state fermentation process [55].

3. Specific Characteristic-Esterases for Cost-Effective Catalysis

The production of extracellular tributyrin esterase was optimised using a bacteria *Micrococcus* sp. isolated from cheese [56]. Hyper-thermophilic esterases have been studied through strategic selection for the resolution of 2-aryl propionic esters [57]. A newer approach for metagenome screening for esterase has been recognised, and in many cases, the sources of esterase occur from metagenomic libraries [28,31]. In an effort to present information on esterases with specific characteristics, for cost-effective catalysis, Table 2 has summarised a selection of microorganisms isolated from extreme environmental conditions. An esterase gene from such an isolated microorganism is cloned in an expression plasmid in a laboratory and then this plasmid is introduced into a host cell for expression of the gene-coded protein. The specific characteristics plasmids have been used to overexpress in *Escherichia coli* for the biosynthesis of esterase enzymes of desired characteristics, such as enzyme activity under lower or higher temperatures.

Esterase capable of retaining its activity in reactions at lower temperatures represents an attractive resource for a wide range of industrial applications [58]. Their catalytic activity retained in cold conditions makes them ideal catalysts eliminating the need for heating the reaction mixture. Otherwise, the higher reaction temperature could affect the quality and sustainability of the desired product, as well as the maintenance of a higher temperature could influence the cost-effectiveness on an industrial scale. Similarly, other classes of esterases active at higher temperatures are useful in those processes, which need to be performed under heated conditions. For such high-temperature reactions, novel thermostable carboxyl-esterases have been prepared using a strain of *Geobacillus stearothermophillus* [59], and by thermo-acidophilic archaeon *Sulfololeus tokodaii* strain [60].

Table 2. Esterases of specific characteristics.

S. No.	Required Characteristics	Producer Strain	References
1	Methanol-stable esterase	*Geobacillus subterraneus* DSM13552	Cai et al., 2020 [61]
2	Organic-solvent tolerance from a halotolerant isolate	*Salimicrobium* sp. LY19	Xin et al., 2013 [62]
3	Thermostable carboxyl-esterase	Geobacillu *kaustophilus* HTA426	Montoro-García et al., 2009 [63]
4	Thermostable esterase	*Geobacillus thermoleovorans* YN	Soliman et al., 2007 [64]
5	Highly thermostable esterase	*Geobacillus* sp. JM6	Zhu et al., 2015 [65]
6	Esterase AhEst	*Acetomicrobium hydrogeniformans*	Kumagai et al., 2018 [66]
7	Cold-active esterase, (*EstLiu*)	Overexpressed in *E. coli* BL21 cloned from marine bacterium *Zunongwangia profunda*	Rahman et al., 2016 [67]
8	Cold-active esterase (*Est11*), solvent and salt tolerant	Marine bacterium *Psychrobacter pacificensis*, expressed in *Escherichia coli*	Wu et al., 2015 [68]
9	Cold-adapted and salt-tolerant esterase	Psychrotrophic bacterium *Psychrobacter pacificensis*	Wu et al., 2013 [69]
10	Cold-adaptation and salt-tolerance	Psychrotrophic bacterium *Psychrobacter celer* 3Pb1	Wu et al., 2013 [70]
11	Cold-adapted esterase, 90% of its max activity at 0–5 °C (*EstPc*)	*Psychrobacter cryohalolentis* K5(T) over-expressed in *E. coli* BL21	Novototskaya-Vlasova, et al., 2012 [71]
12	Cold-active esterase *EstPc*	*Psychrobacter cryohalolentis* K5(T). Expression of AT877 gene in *E. coli BL21(DE3)pLysS*	Petrovskaya, 2015 [72]
13	Cold-active esterase	*Photobacterium* sp. MA1-3 expressed in *E. coli* BL21 (DE3)	Kim et al., 2013 [73]
14	Cold-adapted esterase	*Salinisphaera* sp. P7-4 expressed in *E. coli* BL21 (DE3)	Kim et al., 2011 [74]
15	Cold-active esterase EstC	*Streptomyces coelicolor* A3(2) expressed in *E. coli* BL21	Brault et al., 2012 [75]
16	*EstA* esterase 3HP4	Psychrotrophic strain of *Pseudoalteromonas* sp. *643A*	Brzuszkiewicz et al., 2009 [76]
17	Cold-active and Salt-tolerant esterase	*Lactobacillus plantarum* WCFS1	Esteban-Torres et al., 2014 [77,78]
18	Cold-adapted esterase 4AO6	Sourced from an Arctic intertidal metagenomic library	Fu et al., 2013 [79]
19	Cold-active esterase with improved Thermostability	*Serratia* sp. by directed evolution	Jiang et al., 2016 [80]
20	Cold-adapted esterase	*Acinetobacter venetianus* V28 expressed in *E. coli BL21*	Kim, 2012 [81]
21	Cold-adapted Recombinant esterase	*Pseudomonas mandelii* expressed in *E. coli BL21*	Lee et al., 2013 [82]
22	Cold-adapted esterase, MtEst45	*Microbulbifer thermotolerans* DAU221 expressed in *E. coli* BL21	Lee, 2016 [83]
23	Cold-active and anion-activated carboxyl esterase OLEI01171 3I6Y,3S8Y	*Oleispira antarctica*	Lemak et al., 2012 [84]
24	Cold-active GDSL-esterase	*Pseudomonas* sp. S9 expressed in *E. coli TOP10* pBAD/Myc-HisA	Wicka et al., 2016 [58]

Table 2. *Cont.*

S. No.	Required Characteristics	Producer Strain	References
25	Cold-adapted esterase	*Rhodococcus* sp. AW25M09 expressed in *E. coli* BL21	De Shanti et al., 2014 [85]
26	Cold-active 4V2I	*Thalassospira* sp. GB04J01 expressed in *E. coli* BL21	De Shanti et al., 2016 [86]
27	Cold-adapted esterase	*Alkalibacterium* sp. SL3	Wang et al., 2016 [87]
28	Temperature-sensitive esterase	Chaperone-based *Escherichia coli*	Ferrer et al., 2004 [88]
29	Extremophilic esterases	Sourced from Library of metagenomics	López-López et al., 2014 [89]
30	Cold-adapted Esterase	*Pseudomonas mandelii* EstK	Truongvan et al., 2016 [90]
31	Esterase with high activity and enantioselectivity	*Escherichia coli*	Godinho et al., 2011 [23]
32	Expressed in *E. coli* Rosetta-gami (DE3) pLysS	*Photobacterium* sp. Strain J15	Shakiba et al., 2016 [91]
33	Cold-active pectin methyl esterase	*Penicillium chrysogenum expressed in P. pastoris*	Pan et al., 2014 [92]
34	Thermostable esterase	Thermo-acidophilic archaeon *Sulfololeus tokodaii*	Suzuki (2004) [60]

4. Contribution of Esterase Enzyme to Bioeconomy

In this article, we have included over 60 examples of microbial strains for esterase production, which could be used as efficient and economical biocatalysts contributing to the economy. For a better and clearer presentation, these examples are summarised in two tables. Additionally, the information on the selection of a microbial strain as the producer of a specific esterase is presented in an easy referencing format for the convenience of readers (adding Author–year in Tables 1 and 2).

There are some examples of esterase enzymes with potential applications in the food industry. These enzymes can be sustainably produced in the microbial synthesis process in industrial-scale processes for the benefit of the food industry. These examples include methylesterase used for fruit firming, which contributes to the economy by stopping unnecessary wastage of fruits, caused by over- and fast ripening. This esterase is an acidic and cold-active pectin methyl esterase isolated from a fungal strain *Penicillium chrysogenum*, which was expressed in *P. pastoris* [92]. The enzyme was effective in improving the firmness of pineapple dices significantly when combined with calcium lactate when the performance of enzyme was compared with the results obtained using a commercial product. Thus, esterase is a suitable enzyme for food processing in the fruit and vegetable industry, considering the requirement of low temperature to maintain the quality of fruits. Another example of the benefit of use of esterase application is in the fruit-juice industry where polygalacturonase Endo-PG I enzyme is used to reduce the viscosity of papaya juice by 17.6%. This enzyme increased its transmittance by 59.1% when used in combination with a commercial pectin methyl-esterase [93].

Phenolic acids are significant compounds present in several agricultural residues and wastes, and application of esterase enzyme technology could be a good model for transforming them into products of higher value. Through the biocatalytic activity of esterase freely available renewable bioresources can be utilised for the synthesis of some specialty chemicals such as aromas and flavours as the derivatives of phenolic acids [94]. Greener practices for the extraction of phenolic acids from raw materials, and designing of sufficient heterogeneous biocatalysts to improve the production of phenol derivatives in sustainable processes, would be an approach toward a circular bioeconomy [95,96]. The

biotechnological production of aroma compounds is considered an eco-friendly approach since these bioprocesses can be performed under very mild conditions using enzymes substituting potentially toxic catalysts. Therefore, enzyme-catalyzed processes would have a small number of issues. For the use of agro-industrial residues and by-products, bioprospecting, strain modification, and synthetic-biology have emerged as necessary tools to produce aroma compounds [97]. The production of flavours using a biosystem has been considered an approach aligned with three pillars of sustainability, environmental, economic, and social features [98].

Esterases can economically catalyse those reactions where the chemo-selectivity and regio-selectivity are of importance. A very good example of the use of carboxyl esterases is the release of ferulic acid from renewable bioresources, pectin or xylan polysaccharides present in the plant cell wall. In substrates containing xylans, the molecule of ferulic acid is attached to arabinose residues bound to the xylan configuration. Whereas, in substrates rich in pectins, ferulic acid is attached to galactose or arabinose in side chains. In either case, with the application of esterase, the yield of recovered ferulic acid can be enzymatically converted into vanillin, which is an important flavouring compound widely used globally in the food industry [99,100].

In the pharmaceutical industry, esterification of drugs is a common practice in drug development. There are many advantages to using esterified drugs, as they have better solubility, bioavailability, absorption and increased patient compliance. Esterase enzymes have established their application for the hydrolysis of prodrugs into their active water-soluble forms, with better efficacy compared with the parent prodrug ester [101]. A prodrug with an ester linkage can also be used to deliver two active drugs; this technique was used in the synthesis of many prodrugs that have anti-inflammatory, analgesic, and antipyretic properties. The acetylcholinesterase (AChE) has been studied in immobilised form [102] with enhanced enzymatic performances for biosynthesis of esters. The possibility of biodiesel production by reactions catalysed by immobilised AChE could be an interesting option for a new biodiesel technology. The outcome of this study has recommended the use of AChE-mediated esterification for the synthesis of long-chain ester [103].

5. Conclusions

This review is based on published research on the isolation, characterisation, and modification of microbial strains for the production of esterase enzymes. Their catalytic activities to perform esterification reactions are necessary for the preparation of a specific enantiomer of required efficacy. The other properties of esterase, such as flavour enhancement through the generation of esters, make this enzyme a desirable biocatalyst in the food industry. The esterases with characteristics of thermostability are desired for their application in catalytic processes to be performed at higher reaction temperatures. Esterase produced by microbial strains isolated from low-temperature climatic condition have characteristics of their catalytic activity in several processes operating at a lower temperature. Some preparations of esterase enzyme are required for their catalytic stability in esterification processes using different solvents. Therefore, a different preparation of esterase is needed for a particular biocatalytic activity required in the preparation of specialty compounds used in the food and pharmaceutical industries. This review concludes with the outcome of several studies that a sustainable supply of enzymes can be achieved through the process of biosynthesis by employing a more efficient microorganism.

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