6.2 STRUCTURE OF LAC OPERON

This is the DNA of *E. coli* (Lac-operon). On the left side there is Lac I gene which is regulatory gene then there is CRE region (CAP response element). After that, promoter (*P*) and operator (*O*) region is present. Some part of promoter and operator region overlaps each other. There are three structural genes *i.e.*, Lac Z, Lac Y, and Lac A which synthesizes ß-galactosidase, ß-galactosidase permease and ß-galactoside transacetylase respectively.

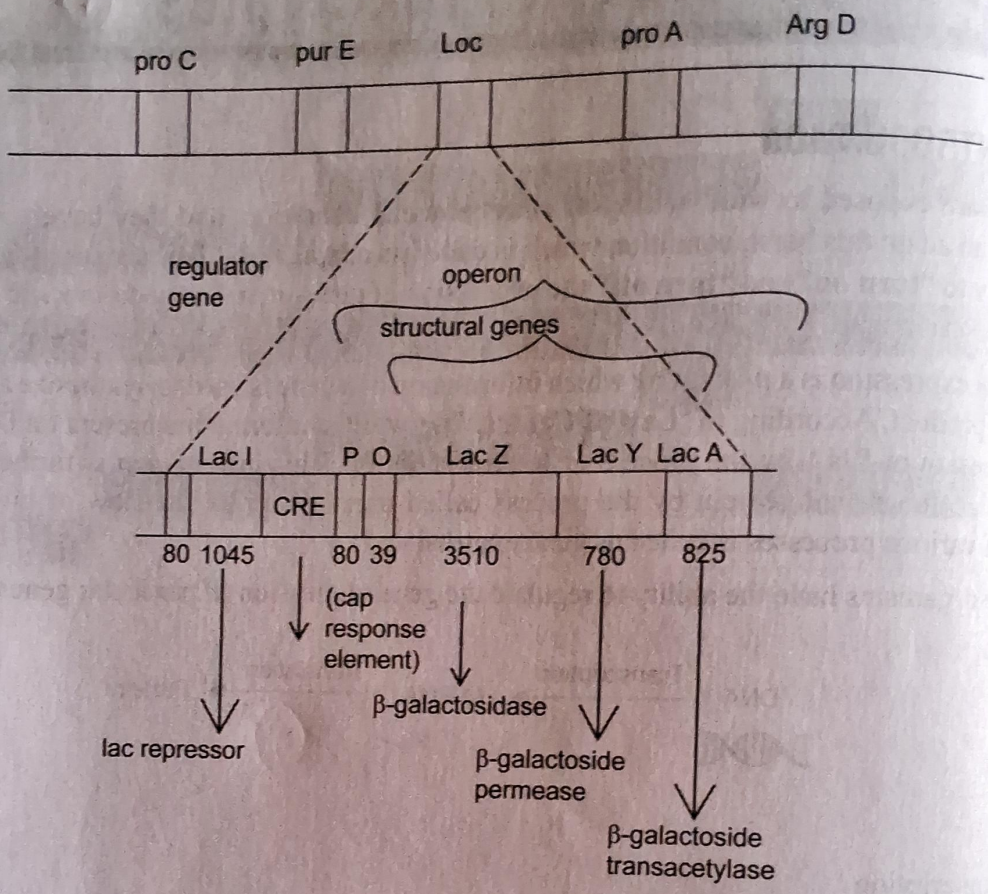

Fig. 6.1. *Structure of Lac-operon.*

6.3 FUNCTION OF THE STRUCTURAL GENES

Lac Z: Lac Z codes for an enzyme ß- galactosidase and is a tetramer of about 500 KDa which breaks ß- galactoside into its sugar components. Ex lactose is broken down into glucose and galactose.

Lac Y: Lac Y codes for an enzymes ß - galactoside permease which is a 30 KDa membrane bound protein that transports ß- galactosides into cells.

Lac A: Lac A codes for ß - galactoside transacetylase which transfers an acetyl group from acetyl-CoA to ß - galactosides

So structural genes codes for a protein with any function like structural and enzymatic while on the left side there is regulatory gene Lac I which codes for a repressor protein that regulates the expression of all structural genes.

Regulator gene codes for a protein that control transcription by binding to a particular site (*s*) on DNA. Thus, affects the accessory proteins which bind to the recognition sites. These accessory proteins can regulate the promoter site in two ways:

- Positive regulation by activators
- Negative regulation by repressors

Lac I genes are controlled by negative regulation which means DNA is transcribed unless turned off by repressor. Repressor is a **tetramer of identical subunits** of 38 KDa each. It binds to operator at the start of the Lac ZYA cluster and prevents RNA polymerase from initiating transcription. So, there are two conditions for Lac-operon.

Condition A: When Lactose is Absent

The regulatory genes are turned on by defaults. The repressor molecule binds to operator which prevents RNA polymerase from initiating transcription. Thus, gene expression turned off. No transcription occurs.

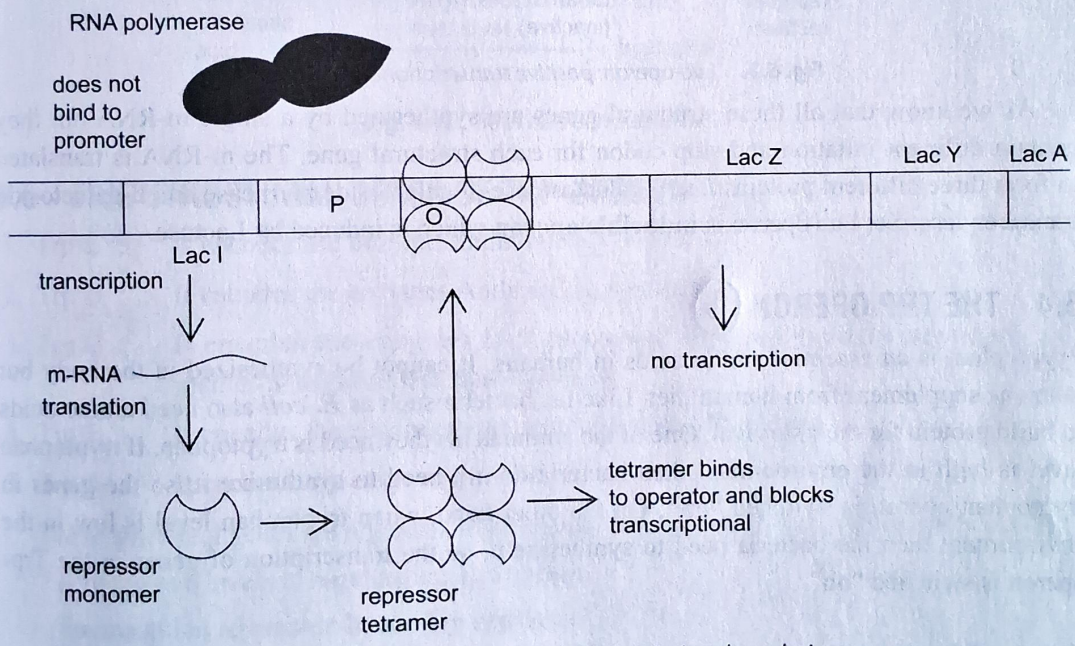

Fig. 6.2. *Lac-operon: negative transcriptional regulation*

Condition B: When Lactose is Present

The regulatory genes are constitutive genes. They are constitutively expressed forming a repressor monomer and combines to form repressor tetramer which is active form of repressor. In this case when lactose is present in the medium than **allolactose** which works as inducer binds to repressor tetramer and made it inactive so that it cannot bind to the operator. So, in this condition operator site is free and on the promoter site RNA polymerase binds which leads to the expression of structural genes.

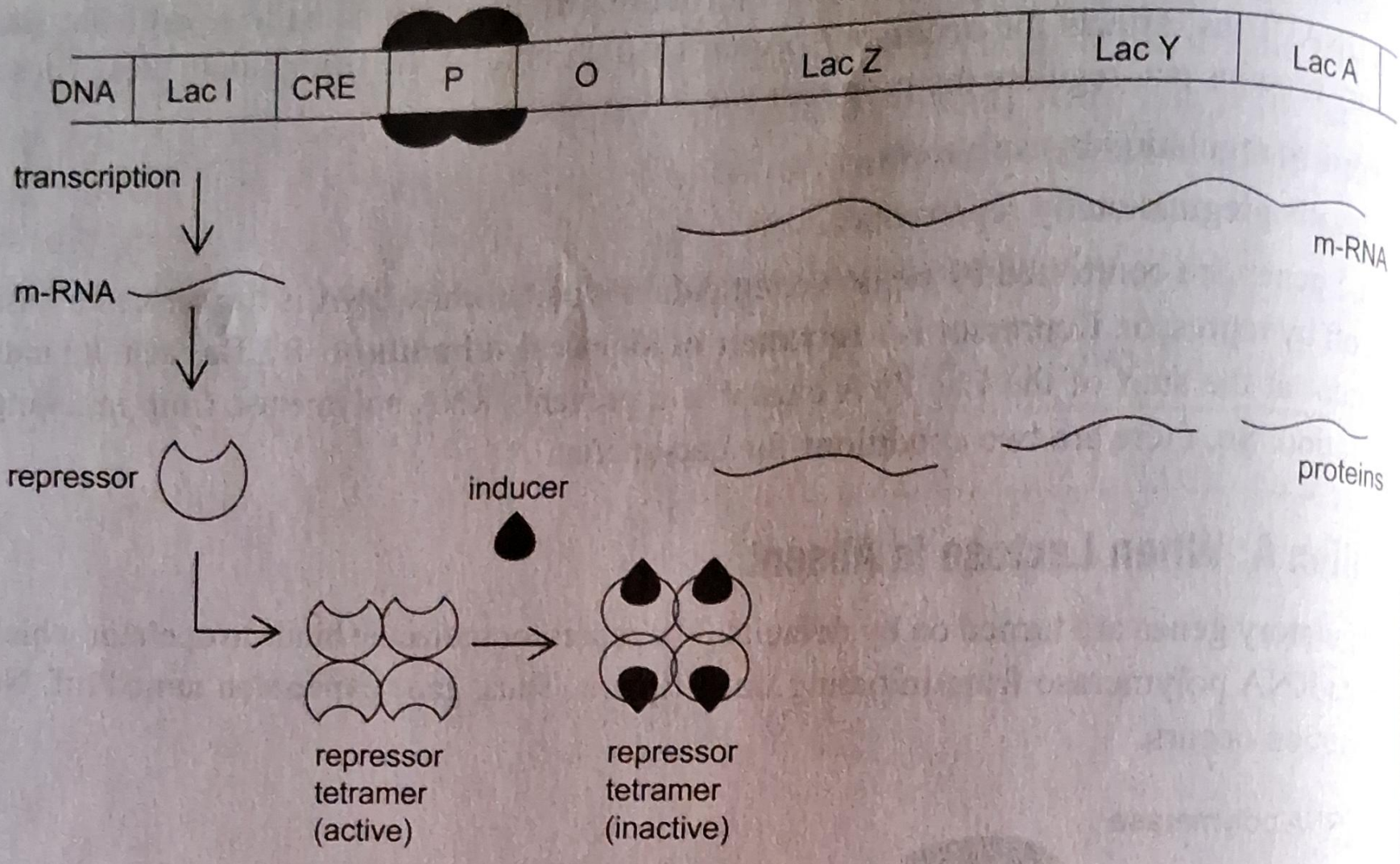

Fig. 6.3. *Lac-operon: positive transcriptional regulation.*

As we know that all these structural genes are synthesized by a single m-RNA but they contain different initation and stop codon for each structural gene. The m-RNA is translated to form three different proteins *i.e.*, ß-galactosidase, ß-galactoside permease and ß-galactoside transacetylase. So, Lac operon is **inducible operon** which is induced by Lactose.