Hello everyone, I'm Dr. Rajesh Parvatkar, assistant professor of

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This lecture is for first year BSC semester One. the paper i

Physical chemistry, and organic chemistry, Section B that is

organic chemistry. The paper code is CHC101 and I'm going

to discuss module number 29 of Unit 2, that is stereochemistry. The name of the module is meso compounds.

This is the brief outline of my today's presentation. I'm

going to discuss meso compounds with regards to their

definition, constitutional symmetry, symmetry elements,

configuration and examples. At The end of the lecture you

will be able to define meso compounds, understand relation

between symmetry and meso compounds, understand the

configurational features of meso compounds, and you'll be

able to identify and differentiate, meso

stereoisomer and its chiral stereoisomers.

So let's begin with the definition of meso compounds. So

What are meso compounds? meso compound is an achiral diastereomer in a

group of a stereoisomer which also contains chiral isomers.

Now, you must be knowing a compound can have many

stereoisomers. Now, one or more stereoisomers from this can be a

chiral due to the presence of symmetry element, and these compounds are called as mezzo. rest All are chiral. so meso

compounds contain symmetry elements. so we can define meso

Compound also, as the compound which has a chiral

center but achiral due to the presence of one or more

symmetry element in it.

Let's understand why there are meso isomers now. This is

because of the constitutional symmetry, the molecules with

constitutional symmetry and chiral centers gives rise to

meso stereoisomers. You need to understand what is

constitutional symmetry. if molecule can be divided in two

halves having identical constitution, then such a

a molecule is set to have constitutional symmetry. Example

is 2,3-dibromobutane. So here you have a molecule CH3CHBrCHBr

CH3. Of which carbon #2 ann carbon #3 are chiral

center. Now I can view this molecule in such a way that I

can see 2 equal halves of these molecules and these two equal

halves are identical in terms of the atoms and the bonds and

therefore this molecule has got the constitutional symmetry in

it. OK, it has got now two chiral center. That means it can

have maximum 4 stereo isomer.Let's write down the stereo

structure in Fischer projection

of. All these are possible stereoisomers. This is the first one, a second one is easy to write. simply write the mirror image here. Then third one I have to just interchange the two groups at the chiral center. Any of the chiral center. I'll get third one and the 4th one is again the mirror image of the third one. OK, so they are basically two pairs of mirror images, But the question is, are these mirror images superimposable or nonsuperimposable on their object?

So let's see whether B is superimposable, mirror image or non superimposable mirror image of A to know that what I will do is that I'll rotate the molecule B through 180 degrees in the plane of the screen. So whatI'll get is the arrangement that is identical to a so B is superimposable on A. So A&B are identical. What it also means that they cannot have non superimposable mirror image and hence a is achiral.

And it has got a chiral center,and therefore it is now to be called as meso. Now, what about

C&D? Are these superimposable mirror images or non superimposable mirror images?Let's see carry out the same exercise as we have done for A&B

and then. We find that rotates through plane of the screen through 180 degrees do not produce is the structure that can be superimposed on C and therefore C&D are non superimposable mirror images and therefore they are chiral stereoisomers in the group.

OK, So what we know is that meso compounds are Compounds which contains symmetry elements in them so you can view a plane of symmetry in a Fischer projection of compound A. You can also view center of symmetry in its sawhorse projection of A and as all achiral compounds have alternating axis of symmetry Meso compounds also have alternating axis of symmetry. So here in will see now symmetry elements. So you know that stereostructures can be written in a different forms like 3D, Fischer sawhorse. OK here I have a 3D view of 2,3-dibromo butane. And I can see now a plane here, right? The plane divides the molecule into equal halves. herein you find that the two equal halves are mirror images of each other.

OK, so this is a plane of symmetry. Now I can see also the plane of symmetry in Fischer projection. I have to simply draw a line in between and divide the molecule in two halves. Two halves are mirror images of each other. The line has to be imagined as a plane, so there's a plane of symmetry. Now

I'll convert this into a sawhorse projection. It's the

eclipsed sawhorse projection, and there is a plane that you can

see. Again this plane divides.

The molecule in two half such that the one half is mirror image of

the other half and therefore you can see a plane of symmetry

In thos sawhorse projection. Now What I will do, I will invert

this carbon Atom by rotating a bond and I'll create a.

Anti sawhorse projection now in anti sawhorse projection you will

not be able to identify a plane which will divide the molecule

in two half such that two halves are mirror images, but there is

a center in the molecule at which if you draw a line in

opposite direction you'll find two groups which are identical.

For example methyl-methyll Bromo and Bromo and

hydrogen and hydrogen and therefore there is a center of

symmetry here. OK so.

Chiral stereoisomers will not have such symmetry elements in

them. You have to note that OK.
now coming to the configurations

of meso compound, let's discuss our configuration. I will not

discuss the Cahn Ingold Prelog rule here, because you already

seen that how to assign configuration now here in this structure, that is meso compound you have three sets of number

one that is written in black, OK these numbers are given to the

carbon atoms 1 2 3 4 then.

Those numbers which are written in green are the

priorities given to chiral center two, OK then those which

are written in the red are priorities given to the groups

at carbon #3. So you can see that priority one is bromine

priority Two is this carbon then priority three Is this and

priority four Is this so if Idraw arrangement line then it is

anticlockwise and hydrogen is beta or on a horizontal line.

Therefore two has “R”

configuration. So similarly,chiral center three has got S

configuration. You can try it out so this compound has 2R3S

configuration. Let's see what are the configurations of chiral

stereoisomers of this. C has got 2S and 3S configuration. You

can try out. I have given everything over here priorities

an arrangement so it has got 2 S and3R . Similarly, the

chiral isomer D, which is enantiomer of C, has got

exactly opposite configuration

2R3R. Now what is the striking feature here? You should see

that meso you have one carbon,R configuration other carbon has got S configuration so this is what you will see in meso

compound opposite configuration at the two chiral centers. Now

let's see erythro and threo

configuration. Now for erythro and threo

configuration you must write Fischer projection in such a way

that maximum number of carbon atoms are arranged in a vertical

line. You have that over here,CH3, then this carbon, then

this carbon and you have this carbon. So you know vertical

line. Then you must see the groups at the chiral center. If

the at chiral center, the identical groups are on the same

side of the vertical line. Here you find that two groups i.e

bromine are Identical on the same side. These Hydrogens also

identical. So what you can say is that such arrangement gives

Erythro configuration.Similarly for chiral isomers

C&D, what you will find that the groups are on the opposite side

of the vertical line across the line. The bromine Atom hydrogen.

Also, you may see that they are opposite same way for the D and

therefore the configuration here threo. Both these are chiral

Isomers. so you can say that meso compound always have a erythro

configuration.

D and L configurationfor
D and L configuration. You will

see that Fischer projection is again written in such a way that

maximum carbons in a chain is kept in a vertical line, an

Oxidized end should be on the top here, and less oxidize should be

at the bottom, but here you don't have that a question

because both the ends areequally oxidized. Then you must

look at the lower most chiralcenter, but Please note that you

cannot assign D and L configuration.

to a meso compound or achiral compound. This is by rule. so no

configuration can be given to a meso compound, but you can give

configuration tochiral isomers C&D. OK, how to give that?

You have to look only at the lowermost chiral center. at

lowermost chiral center The functional group that is

bromine here if it is in left then the configuration

is L OK and you see can see.In this, bromine is in the

right and therefore the configuration is D. So this

is how the configuration has to be assigned. So what you

learn here is that meso compound cannot be assigned

with D and L configuration. OK,now let's take more examples

of meso compounds.

Tartaric acid, it is one of the examples. You have two chiral

center here and the constitutional symmetrical again. It will have three stereoisomers just like 2,3-dibromo butane. I have written two over here. But which one is

Meso? You know that Fischer projection can be written in

several ways. Now this Fischer Projection do not give an idea

whether this contains symmetry element or not and to know

whether there is a symmetry element. What you should do is

that try to write in a systematic Fischer projection.

Systematic Fischer projection is that this COOH group

should have been over here. OK,so maximum carbons in vertical

line. OK, now to do that you cannot simply replace H by COOH, so

you have to rotate in a triad.So can you get this particular

structure now? There is no plane of symmetry that you can view

over here, and therefore this has to be chiral, so this is

chiral. Let's try out Y. OK,now I have to again rotate this

COOH and again I want to bring this OH over here. OK so I have

to rotate that also and what Produce is this now perfectly I

can have a line which is a plane of symmetry dividing the

molecule into equal half and

this Y Is actually meso. So in the structure Y over here you

might not find the symmetry element which can be viewed

easily but it is Meso.

OK, so try writing this third stereoisomer of tartaric acid,

which will be chiral. OK, there are more examples. 3,4-dimethylhexane. planar structure here and then meso stereoisomer.

I've written because it has got a plane of symmetry, then 1,2

diChlorocyclopropane here planar structure and you can see

a plane of symmetry. OK here you have to draw a plane which will

divide the molecule in two halves of which are mirror

images. So this is meso.

These are the references.

Thank you.