# SOME BACTERIA ISOLATED FROM MARINE PLANKTON AND MUD

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Fiftyseven bacterial strains isolated from marine plankton and mud from the inshore waters of Cochin are described. The flora of the plankton was dominated by chromogens while mud samples failed to produce chromogens. The different strains are divided into five arbitrary groups for the convenience of description. The flora is similar to that of Mandapam (east coast) while it differed from the flora of Calicut (west coast) in the paucity of *Bacillus* sp and other sporeformers.

### INRODUCTION

Heterotrophic bacteria occurring in the marine environment have been receiving considerable attention in recent years. Marine bacteriological investigations have been carried out both on the west and the east coast of India by different workers. Velankar (1950) studied the bacterial population of the surface water, relative abundance of bacteria in the seawater and in association with plankton off Madras city (Bav of Bengal). He also made qualitative and quantitative studies on occurring in the inthe bacteria shore environment at Mandapam (Velankar, 1955, 1957). Venkataraman and Sreenivasan (1954a, 1954b, 1956) examined the bacterial flora of the seawater off Malabar coast and off Tuticorin on the east coast. Santhakumary (1966) and Gore (1971) made some observations on the bacterial flora of the Cochin backwaters and Cochin beach respectively. While studying the quantitative abundance of bacteria in the mud and in the plankton tows off Cochin, the author isolated a number of bacterial strains and this paper includes detailed description of morphological and biochemical features of these isolates.

#### MATERIAL AND METHODS

Samples of plankton and mud were collected from a fixed station in the inshore region. Plankton was collected in organdie net and mud from a depth of 6 fathoms was collected in a grab. The samples were carried to the laboratory in sterile glass containers, immediately after sampling. Standard procedures (Karthiayani and Mahadeva Iyer, 1967) were employed in studying the morphological and biochemical features. Plankton samples were carefully ground in a mortar and then plated. Generic indentification of the isolates was done according to a modified scheme of Simidu and Aiso (1962).

#### **RESULTS AND DISCUSSION**

A total of 57 strains were isolated,

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25 from plankton and 32 from mud. Five of the isolates did not grow well and hence could not be studied further. The different isolates are classified into 5 arbitrary groups for convenience of description, mainly based on their gram stain reaction and ability to ferment sugars.

- i. Gram negative non-sporing motile rods capable of fermenting two or more sugars.
- ii. Gram negative non- sporing motile rods capable of fermenting only one sugar.
- iii. Gram negative non- sporing motile rods not capable of fermenting any of the sugars.
- iv. Gram negative cocci capable of fermenting at least one sugar.
- v. Gram positive sporeforming rods.

These different groups are dealt with in tabular from. It is obvious from the the tables that majority of the strains fell in group I. All the isolates were aerobic and showed satisfactory growth at room temprature  $(30^{\circ}C + 1^{\circ}C)$ . In general the flora is fairly reactive. While gelatin liquifaction, nitrate reduction, ammonia production from peptone and fermentation of sugars are exhibited by majority of the isolates, indole is produced only by a few. Gram negative nonsporing motile rods predominated the flora, a few gram nagative cocci and two gram positive spore-forming strains (Bacillus sp.) were encountered. All the Flavobacterium sp. producing yellow, red and orange pigments were isolated only from plankton and none from the mud. They were less saccharolytic and only one of them produced indole. Velankar (1955) also had isolated chromogens only from surface waters and none from mud samples from the east cost. All the 8 denitrifiers, viz; strain nos, 3a, 4a, 14a, 15a, 16a, 27a, 28a, 29a, isolated were of Pse*udomonas* sp. and all were from mud samples. Velankar (1955 *loc cit*) also reported denitrifiers from mud samples only.

Nitrate reducers were present both in plankton and mud. However, they were more frequent in mud samples than in plankton. 7 strains showed good growth on freshwater agar medium (strain nos: 1a, 7a, 16a, 17a, 27a, 31a, and 32a) suggesting their probable non-marine origin. In general the flora is similar to that reported from Mandapam (east coast.) There was no abundance of *Bacillus* sp. and other sporeformers unlike at Calicut as observed by Venkataraman and Sreenivasan (1954 *loc cit*).

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S. No 1	Source	Shape of the colony on seawater agar slant, 3	Growth on seawater Gro peptone 4	owth on seawater agar slant 5	Growth on freshwa agar slant 6	iter Morphology 7
1	Plankton	Greenish yellow, round surface colony,	Moderate growth,medium turbid,	n Filiform	Very poor growth	Gram negative, non- sporing, motile, stumpy, short rods with polar flagella- tion.
2	"	Red coloured surface colony.	Medium slightly turbid, a thin reddish pellicle at the top.	Effuse, dry.	No growth	Gram negative, non- sporing motile rods
3	25	Orange, round surface colony.	Medium turbid	Filiform lux- uriant growth.	No growth	Gram negative, non- sporing motile rods.
4	<b>35</b>	Mucoid ridged, white, surface colony.	Medium turbid, a pellicle at the top.	Effuse	No growth	Gram negative, non- sporing motile short rods.
5	<b>,</b> ,	Mucoid ridged, orange surface colony.	Medium turbid, a thick pellicle at the top, which crumbled into pieces on shaking.	Filiform	No growth	Gram negative, nonsporing motile elongated rods.
6	"	Rose coloured large (1.7mm) surface colony	Uniform turbidity	Effuse (very poor growth).	No growth	Gram negative, non- sporing motile short rods.
7	,,	Pale white almost trans- parent, round, surface colony with bluish irridescence	Uniform turbidity	Filimform luxu- riant growth	No growth	Gram negative non- sporing motile elongated rods.

Voj	1	2	. 3	4	5	6	7
IX No	8	<b>,</b>	Greenish yellow, large (1.5mm) surface round colony.	"	Beaded luxuriant yellowish in colour	No growth	Gram negative non- sporing short, stu- mpy motile rods.
1 1972	8a	Mud	Dull white large (1.6mm) colony with irregular margins	Medium almost clear. Poor growth	Echinulate	No growth	Gram negative non- sporing motile short rods
	9a	"	Dull white round deep colony	Uniform turbidity	do (bluish irridescence)	"	Gram negative non- sporing elongated motile rods
	10a	"	Cream coloured colony	Uniform turbidity	do	,,	Gram negative non- sporing short rods, passive.
	11a	,,	Dull white large (1.7mm) colony with irregular margin	Medium turbid a pellicle at the top	do	No growth	G1am negattve non- sporing motile short rods
	13a	"	Large (1.4mm) white colony	Uniform turbidity	-do- (bluish irridescence)	No growth	Gram negative non- spiring motile short rods
	15a	33	Pale whit deep colony	Uniform turbidity	Effuse	Slight growth	Gram negative non- sporing motile rods
	16a	2 23	Dirty white amoeboid colony	Uniform turbidity, a thin pellicle at the top	Echinulate	Good growth	Gram negative motile rods
51	17a	55	Pure white colony with crenulated margins	Medium higly turbid	-do- (mem- branous)	Good growth	Gram nagetive non- sporing motile short rods

1	2	3	4	5	6	7
19a	",	Punctiform grey colony	Uniform turbidity	-do- (luxuri- ant)	No growth	Gram negative nonspo- ring motile short rods
24a	95	Large (1.7mm) white deep colony	Heavy turbidity	Filiform, moist	No growth	Gram negative non- sporing motle elongated rods
13	Plankton	White rough colony with concentric rings	Medium turbid, a thin pellicle at the top	Filimform	No growth	Gram negative nonspori motile elongated rods.
15	,,	Rose coloured large (1.4mm) raised colony	Medium turbid	Filiform dry growth	, ,,	Gram negative nonspor motile rods.
17	,,	Pure white transparent raised colony	Uniform turbidity	Beaded	Moderate growth	Gram negetive nonspor short stumpy rods, passive movements.
		Dull white opaque surface colony	Medium slightly turbid	Effuse	No growth	Gram negative nonspor elongated motile rods.
19	"	White large (1.4mm) opaque surface colony	Uniform turibidity	Filiforn	\$\$	Gram negative nons ring elongated rods, motile, with pointed er
20	"	Orange, spreading colony	Medium turbid, a pellicle on the top.	Filiform	59	Gram negative nonspor motile rods
22	,,	Orange, large (1.2mm) round colony	Heavy turbidity	Filiform	59	Gram negative nonspor short rods
25	,,	Dull white amoeboid colony	Uniform turbidity	Effuse, moist	<b>99</b>	Gram negative nonspor short motile rods

VOL	1		2	3	4		5	6		7
IX N	1a	Mud	White round colony	surface	Medium slightl a pellicle at the	y turbid top	Effuse	Good growt	h Gram ing mo	negative non-spor- tile rods
lo 1	3a	"	White surfac crenulated m	e colony argins	Uniform turbi	dity	Filiform, b ish irridesce	lu- Poor growth	Gram r motile	negative non-sporing rods
1972	7a	"	White spread colony	ling surface	Uniform turbic	lity	Echinulate	Good growth	n Gram motile with p	negative nonsporing elongated rods pinted ends
	27a	Mud	White, deep irregular sha	colony, ipe	Heavy turbidit	ý	Filiform, m	oist Good growth	n Gram motile curved	nagative nonsporing rods with few cells
	28a	"	Pure white o	val colony	Uniform turbid	lity	- do d	o- No growth	Gram motile	negative nonsporing rods.
					b) Biochemie	cal featur	es of the iso	lates		
	S.No.	Source	Nitrate reduction to nitrite.	Ammonia productio from pept	Gelatin n liquifaction one	Indole producti	Sensitivity on towards penicillin 2.5 IU/ Disc	Fermentation of sugars (glucose, maltose, mannito & lactose)	Hugh and Leifson's ol medium ( study mod attack of	to Bacterial genus e of
	1	F 2	2 3	4	5	6	7	8	glucose) 9	10
	1.	Plan	kton +	~ <del>†</del> ~	+	austro,	+	Acid from gluco maltose & mann did not ferment la	se, NF itol, actose	Pseudomonas sp
5	2.	99	2203	a fa	- <del> </del> .		+	Acid from gluco maltose only	se & NF	Flavobacterium sp

4	1	2	3	4	5	6	7	8	9	10
	4,	<b>39</b>	+	еþ	<u></u>	ŞARTER -	<b>1</b>	Acid from glucose, maltose & mannitol, did not ferment lactose	NF	Pseudomonas sp.
	5	33	-	4	ಧ್ಯಾಜ	al al an	<u>≂</u> +-	Did not ferment lactose; acid from the rest	NF	Flavobacterium sp.
	6	99	<del>⊷</del> †⊷	+		+	4	Did not ferment lactose; acid from the rest	NF	Flavobacterium sp.
	7	,,	ج <del>ار</del>	·+-	+ (slow,10 days)		Penda	Did not ferment lactose; acid from the rest	NF	Pseudomonas sp.
	8	39	-	<del>4</del> 7	+	_	tina.	Acid from glucose, slight acid from maltose and mannitol. Did not fer- ment lactose.	NF	Pseudomonas sp.
	13	35	4		+	Landow P	unary	Acid from glucose, mal- tose and mannitol. Did not ferment lactose.	NF	Pseudomonas sp.
TÌ	15	35	4	+	uso		<b>-</b> ∔-	Acid from glucose, mal- tose and mannitol Did not ferment lactose.	NF	Flavobacterium sp.
reuppy Te	17	• 3	- <del>]-</del>	. +	• <del> </del> •	, .		Acid from glucose, mal- tose and mannitol. Did not ferment lactose.	NF	Flavobacterium sp.
	18	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	- <del> -</del>		·			Acid from glucose and lactose. Did not ferment mannitol and lactose.	NF	Pseudomonas sp.

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¶0	1	2	3	4	5	6	7	8 9 10
L IX No	19	>>	+		+		_	Acid from glucose, mal- tose and mannitol. Did not ferment lactose. FNG Vibrio sp.
1 1972	20	59 <sup>:</sup>	+	еţ»	+	alonget.		Acid from glucose and mannitol. Did not ferment maltose and lactose. FNG <i>Flavobacterium</i> sp.
	22	,,	_		+	, norm	+	Acid from glucose NF Flavobacterium sp. maltose and mannitol. Did not ferment lactose.
	25	"	÷	4	+			Acid from glucose, mal- NF <i>Pseudomonas</i> sp. tose and mannitol. Did not fermant lactose.
	1a	Mud	+				_	Acid from glucose, mal- FNG Vibrio sp. tose and mannitol. Did not ferment lactose.
	3a	29	+ (redu nitri free	uced + ite to N)	+		 -	Acid from glucose and FNG <i>Pseudomonas</i> sp. maltose. Did not ferment mannitol and lactose.
	7a	<b>&gt;</b> 2	+		+ .	+		Acid from glucose, mal- FNG Vibrio sp. tose and mannitol. Did not ferment lacotse
† D	8a	>>	+	~~	+	+		Acid from glucose and FNG <i>Vibrio</i> sp. maltose. Did not ferment mannitol and lactose.

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56	ļ	2	3	4	5	6	7	8	9	10
	9a	و و	<u>,</u>  +	+	<del></del>	<b>+</b> +-	-ţr	Acid from glucose, mal- tose and mannitol. Did not fermant lactose	FNG	Achromobacter sp.
	10a	28	+	·+	+ (slow 10 days)	+	+	Acid from glucose and maltose. Did not fermer mannitol and lactose.	NF at	Achromobacter sp.
	11a	99	u‡+	+	+	- <del> -</del>	÷	Acid from glucose and maltose. Did not ferment mannitol and lactose.	FNG	Achromobacter sp.
	13a	99	- <del>1</del> -		+	+	+	Acid from glucose, mal- tose and mannitol. Did not ferment lactose.	FNG	Achromobacter sp.
	15a	99	+ (reduced nitrite to free N)	+	+ (slow)	+		Acid from glucose and mannitol. Did not ferment maltose and lacto	NF ose.	Pseudomonas sp.
	16a	55	+ (reduced nitrite to free N)	+	+	بىمى	4	Acid from glucose and maltose. Did not fermer mannitol and lactose.	NF t	Pseudomonas sp.
FISHERY T	17a	35	+	terment	+	<del> -</del>	+	Acid from glucose, maltose and mannitol. Did not ferment lactose.	NF	Achromobacter sp.
ECHNOLOG	19a	>>	μ	_	+	~ <del> -</del>	-+-	Acid from glucose malto & mannitol. Did not ferment lactose	se NF	Achromobacter sp.

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Voi	1	2	3 4.	5	6	7	8		9	10
. IX No	24a	, ,,	+ —	_	+	+ A n n	Acid from gluco naltose. Did n nannitol and la	ose and ot ferment ctose.	NF .	Achromobacter sp.
1 1972	27a	"	+ (reduced + nitrite to free N)		_	— A r 1	Acid from gluc naltose. Did r mannitol and la	ose and lot ferment actose	NF j	Pseudomonas sp.
	28a	"	+ (reduced + (s) nitrite to free N)	low) —	_	2 — 1 1	Slight acid from maltose and ma Lactose not fer	n glucose .nnitol. mented	NF J	Pseudomonas sp.
	NF =	non-ferme	entative FNG = Fe	ermentative no gas				www.commune.commune.commune.com		
	NF: N	on-ferment	ative.	GROUP II a)	Morph	IOLOGICAL FE	ATURES	]	FNG: Fe	rmentative, no gas.
	S. No:	Source	Shape of the colon on seawater agar sla 3	y Growth on s ant peptone 4	eawater	Growth or agar slant 5	n seawater a	Growth on Igar slant 6	freshwa	ter Morphology 7
	10	Plankton	Orange coloured, large round colony.	e Medium modera turbid, a thin pellicle at the to	ately op	Filiform dry growth	No	growth	Gram sporin rods.	negative non- g short motile
	11	<b>)</b> 9	Greenish yellow, pun- ctiform, surface colony	- Medium almost turbid		Beaded, mo growth, yel in colour	oist No llowish	growth	Gram 1 sporing	neative non- ; motile short rods.
	14	<b>&gt; &gt;</b>	Pure white, myceloid large colony (1.4 mm)	Uniform turbidi )	ty	Echinulate, irridescence	, bluish No e	growth	Gram 1 ring 1	negative non-spo- notile elongated

1	2	3	4	5	6	7
2a,	Mud	Dull white, punctiform colony	Medium almost clear, poor growth	Effuse	Slight growth	Gram negative, non-spo., ring motile elongated rods, arranged in twos,
4a	<b>\$</b> \$	Dull white, deep colony	Uniform turbidity	Filiform luxuriant	Poor growth	Gram negative non-spo- ring short rods
5a	<b>9</b> 3	Pale yellow, round colony with smooth surface	Uniform turbidity slightly yellowish	Arborescent growth	No growth	Gram negative, non-sop- ring motile short rods.
6а	95	Large, dull white, surface colony	Uniform turbidity	Filiform	No growth	Gram negative non-spo- ring motile short rods,
12a	99	Dirty white, round surface colony	Uniform turbidity a pellicle at the top	Echinulate	3 9	Gram negative, nonspo- ring motile short rods.
14a	95	Dull white round colony	Uniform turbidity	do	99	Gram negative nonspo- ring motile short rods.
21a	25	White large (1.3 mm) colony, having covex surface	Uniform turbidity	do	99	Gram negative nonspo- ring motile short rods.
22a	<b>9</b> 9	Large semitransparent dull white, colony	Medium turbid, a pellicle at the top	Filiform	Poor growth	Gram negative nonspo- ring motile short rods.
26a	,	Dull white, deep colony	Slight turbid medium	Effuse, moist	No growth	Gram negative nonspor- ring, motile elongated rods.
29a	>>	White, large (1.2mm) colony with enlarged horns.	Medium almost clear, poor growth.	Filiform, membranous	No growth	Gram negative nonspor- ing elongated motile rods.

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	Bacterial genus	10	ıcterium sp.	.b.	nonas sp.	nonas sp.	sp.	nonas sp.	<i>bacter</i> sp.	obacter sp.
	aifsons' tudy ck		Flavoba	Vibrio :	Pseudoi	Pseudon	Vibrio	Pseudor	Achromc	Achrom
	Hugh and Le medium (to s mode of atta of glucose)	6	FNG	FNG	NF	NF	FNG sst.	NF	NF	FNG
IONS OF ISOLATES	Fermentation of sugars (glucose, maltose, mannitol and lactose)	8	Acid from glucose only. Did not ferment the rest.	Acid from maltose alone. Did not ferment glucose, mannitol and lactose.	Acid from glucose only. Did not ferment the rest.	Did not ferment glucose mannitol and lactose: Acid from maltose only.	Slight acid from glucose only. Did not ferment the re	Acid from glucose only Did not ferment the rest	Acid from glucose only. Did not ferment the rest	Acid from glucose only. Did not ferment the rest
EMICAL REACT	Sensitivity towards penicillin 2.5 IU/Disc.	2	÷	1	1	 :1	1	1	+	÷
b) BIOCHI	Indole produc- tion	9	·	ł	[		1	I	***	
~	Gelatin liquifac- tion	5	+	+	+	÷	<b>I</b>	+	+	+
	Ammonia production from pep- tone	4	÷	+	-	+	l	ted +	Į	
	Nitrate reduction to nitrite		ton +	+	+	+	+ P	+(reduct nitrite to free N)		+
	Source S No <sup>.</sup>	1 2	10 Plank	., 11	14 "	24 ,,	2a Mu	4a ",	5a »,	6a »,
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0 1	2	3	4	5	6	7	. 8		9	10
12a	25	-fa	eff.		einitia additionalitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitikaelitik	+	Acid from gl Did not ferm	ucose only, ent the rest	FNG	Achromobacter sp.
14a	ced r	+(redu- hitrite to free	+ N)	+	,	Contina	Acid from glu Did not ferm	ucose only, ent	NF	Pseudomonas sp.
21a	33			c	cta		Acid from glu Did not ferme	ucose only. ent the rest	FNG	Achromobacter sp.
22a	> 9	4	~ <del>~</del>	KQ MA (27	<del></del>	4=	Slight acid fro Did not ferm	om glucose only. ent the rest	NF	Achromobacter sp
26a	39		ধল্যন্থ		400 <b>1</b>	÷	Slight acid fro only. Did not	om glucose ferment the rest.	NF	Achromobacter sp.
29a	ced n	+ (redu- hitrite to free	+ N)	57 - 100	-	6-443	Acid from glu not ferment th	cose only Did he rest.	NF	<i>Pseudomonas</i> sp.
<u>gri takan kan</u> dari.					GROUP III	a) Mor	phological feat	ures		
S. N	ource Jo.	Shape of th seawater ag	ne colony on gar slant	Gro pept	wth on seawater one	Grow agar s)	th on seawater lant	Growth on freshwater agar slant,	Morpholog	у .
3 P	lank- ton	Orange, rou colony.	and surface	Med	lium turbid	Filifor riant g	rm luxu- growth	No growth	Gram nega motile rod	tive, nonsporing s.
9	<b>9</b> 9	Dull white, with crenul margins	oval, colony lated	d Gro the t	wth mainly at top, medium	Filifo	rm	No growth	Gram nega elongated	tive non-sporing motile rods with
16	59	Golden yell round colo	low, surface ny.	Med ow pelli	lium golden yell- with a thick cle.	Filifor yellow	m, dry, in colour.	No growth	Gram nega elongated i	tive, non-sporing notile rods.

Source	Nitrate reduction	Ammonia production	Gelatin liquifac-	Indole produc-	Sensitivity towards pen-	Fermentation of sugars (glucose.	Hugh an medium	d Leifsons (to study	Bacterial
S. No.	to nitrite	from peptone	e tion	tion	cillin 2.5 IU/ Disc.	maltose, mannitol and lactose	mode of of glucos	attack se)	genus
3 Plankton	+	+	+	_	+ .	Did not ferment any of the sugars.	y NF	Fla	wobacterium sj
9 "	+	+			-	Did not ferment an of the sugars.	y FN	G Vi	brio sp.
16 "		+			+	Did not ferment any of the sugars.	y NF	Fla	wobacterium s
			GROU	JP IV a)	Morphologica	L FEATURES			
a	Shape of the	he colony	Growth on s	eawater	Growth on se	awater Growth of	on fresh-	Morpholo	
Source S. No.	on seawate	er agar plate	peptone		agar slant.	water aga	ir slant.		gy
Source S. No. 18a Mud	on seawate White, pur colony.	er agar plate	Medium alm poor growth	lost clear,	Effuse	No growt	h	Gram nega mesh like a	gy tive <i>cocci,</i> urrangement.
Source S. No. 18a Mud 20a ,,	On seawate White, pur colony. Transparen with irregu	er agar plate netiform nt colony alar margins	Medium alm poor growth Uniform tur	iost clear,	Effuse Echinulate, m	No growt oist -do-	h	Gram nega mesh like a Gram nega	gy tive <i>cocci,</i> urrangement. tive <i>cocci</i> .

Source S. No,	Nitrate reduction to nitrite	Ammonia production from pept- one	Gelatin liquifac- tion	Indole produc- tion	Sensitivity towards peni- cillin 2.5 IU/Disc,	Fermentation of sugars I (glucose, maltose, mannitol and lactose)	Hugh and Leif- sons' medium	Bacterial genus
18a Mud	- <u> </u>	Anna an			+	Acid from glucose only. Did not ferment the rest.	NF	Achromobacter sp.
20a ,,	<del>.   .</del>	4	Ļ	+	écona.	Acid from glucose, maltose and mannitol. Did not ferme lactose,	NF ent	Achromobacter sp,
23a ,,	÷	<del>.   .</del>	set-s	÷	+	Acid from glucose only. Did not ferment the rest.	NF	Achromobacter sp.

GROUP V a) MORPHOLOGICAL FEATURES

S. No.	Source	Shape of the colony on seawater agar plate.	Growth on seawater peptone	Growth on seawater agar slant	Growth on freshwater agar slant	Morphology
31a	Mud	Blackish surface colony	Medium almost clear, growth mainly at the to	Filiform op	Good growth turning black after 48 hours	Gram positive spore. forming rods, rather passive.
32a	"	Reddish surface colony	Uniform turbidity medium reddish	Filiform growth reddish in colour	Moderate growth reddish in colour	Gram positive spore- forming motile rods.

Vor	в) Вюснемісл							CAL FEATURES			
IX No I	S. N	ource o.	Nitrate reduction to nitrite	Ammonia production from peptone	Gelatin liquefac- tion	Indole produc- tion	Sensitivity towards peni cillin 2.5 IU/Disc.	Fermentation of sugars (glucose maltose, manni- tol and lactose)	Hugh and Leifson's medium	Bacterial genus	
1972	31a	Mud	÷	÷	ł	+		Acid from glucose and maltose only. Did not fer- ment mannitol and lactose.	NF	Bacillus sp.	
	32a	>>	+	4	+	- <del> -</del>		Acid from glucose, malt- ose, mannitol. Lactose not fermented.	FNG	Bacillus sp.	