THE IDENTIFICATION OF \textit{GARDNERELLA VAGINALIS}

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\textbf{SUMMARY.} A collection of 72 strains of catalase-negative gram-positive, \textit{-}negative and \textit{-}variable coccus-bacilli isolated from samples of vaginal discharge from women with non-specific vaginal infection was examined in an attempt to develop an identification system for \textit{Gardnerella vaginalis} that could be used in a diagnostic laboratory. Carbohydrate fermentation tests were found to be poorly reproducible and of little differentiating value. Enzyme tests were found similarly unhelpful, as were many antibiotic-susceptibility and chemical-inhibition tests. However, seven tests—susceptibility to trimethoprim and two concentrations of metronidazole, growth in the presence of 2\% (w/v) sodium chloride and on nutrient agar, lactic acid production from glucose and \textit{\beta}-haemolysis on human-blood agar—were used successfully in this study to separate \textit{G. vaginalis} from catalase-negative coryneforms and lactobacilli. Of these tests, susceptibility to trimethoprim and metronidazole together with \textit{\beta}-haemolysis on human blood agar are the most likely to provide a rapid, accurate identification. A possible identification scheme is outlined.

\textbf{INTRODUCTION}

Controversy about the role of \textit{Gardnerella vaginalis} in the healthy and diseased human vagina has existed for many years. The difficulties of isolation, identification and taxonomy of the organism have contributed to this to some extent (Dunkelberg, 1977). The organism was first described by Leopold (1953). In 1955, Gardner and Dukes isolated it from 92\% of cases of non-specific vaginitis and proposed the name \textit{Haemophilus vaginalis}. This gained widespread acceptance at the time, although no special requirement for growth factors could be demonstrated (Dunkelberg, 1977). In 1961, Lapage suggested that the organism might be a corynebacterium. Zinnemann and Turner (1963) reported that the organism was gram-positive and suggested the name \textit{Corynebacterium vaginale}, which was then widely used in the 1970's. However, there were objections to the inclusion of this organism in the genus \textit{Corynebacterium}: it is catalase negative, unlike most other coryneforms, and electron microscopy shows that its cell wall structure is like that of a gram-negative bacterium (Criswell \textit{et al.}, 1972). In 1979, Greenwood and Pickett performed a detailed taxonomic study on 78 isolates and reference strains and found that there was no genetic relationship between

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it and members of the genera Haemophilus, Pasteurella or Streptococcus. The formation of a new genus, Gardnerella, for all organisms previously designated Haemophilus vaginalis or Corynebacterium vaginale, was proposed by Greenwood and Pickett and supported by Piot and his colleagues, who also performed a detailed taxonomic study on a collection of G. vaginalis strains and related organisms (Greenwood and Pickett, 1979; Piot et al., 1980).

The problems of identification of G. vaginalis in the diagnostic laboratory can be associated with the confused taxonomy. The reaction to Gram’s stain is variable so that even this basic tool for identification is of little help. Carbohydrate-fermentation tests often pose problems of reproducibility (Edmunds, 1962; Dunkelberg, Skaggs and Kellogg, 1970; Bailey, Voss and Smith, 1979; Greenwood and Pickett, 1979; Piot et al., 1980), and although glucose, maltose and starch are almost invariably fermented (Dunkelberg, 1977), this is of little use for identification purposes as these carbohydrates are also fermented by a wide variety of other bacteria (Piot et al., 1980).

It has been suggested that the ability of G. vaginalis to produce diffuse β-haemolysis on human- but not horse-blood agar can be used to give a presumptive identification (Greenwood et al., 1977; Bailey et al., 1979; Wells and Goei, 1981). However, it appears that other bacteria frequently isolated from the female genital tract may occasionally produce similar haemolysis (Smith, 1979; Piot et al., 1980).

Two study groups have suggested that the sensitivity of G. vaginalis to high concentrations of metronidazole, which is unusual in facultatively anaerobic bacteria, may aid a rapid presumptive identification (Smith and Dunkelberg, 1977; Bailey et al., 1979). However, Bailey and his colleagues reported that some bifidobacteria and organisms referred to as H. vaginalis-like were also sensitive to high concentrations of metronidazole.

A simple, reproducible and accurate system for the identification of G. vaginalis has, therefore, yet to be devised. This study was undertaken in an attempt to produce such a system.

**Materials and methods**

**Bacterial strains**

The strains examined were taken from a collection of facultatively anaerobic bacteria isolated from the vaginal secretions of women with non-specific vaginal infection (Taylor et al., 1982). All catalase-negative gram-positive, -negative or -variable coccobacilli, that produced pin-point colonies after incubation for 48 h in 10% CO₂ in air were included. The type strain of G. vaginalis NCTC 10287 and three characterised strains of G. vaginalis (nos. V-7854, V-8821 and V-9477) provided by Professor L.V. Holdeman, Virginia Polytechnic Institute and State University Laboratory, Blacksburg, VA, were also included.

Strains were maintained on blood agar plates (Columbia Agar, Oxoid CM331, with 7% (v/v) defibrinated horse blood), subcultured at 3-day intervals and incubated in 10% CO₂ in air. All isolates were stored in liquid nitrogen, suspended in thioglycollate broth with glycerol 10% (v/v) and defibrinated horse blood 10% (v/v).

A total of 72 strains was examined in this study. Seven tests, listed in table I, were used to group the isolates provisionally. Lactic acid production was included to separate lactate-producing organisms such as lactobacilli from G. vaginalis and related organisms. All other tests were selected from those previously reported to be of use in the separation of G. vaginalis from related organisms (Greenwood et al., 1977; Bailey et al., 1979; Piot et al., 1980).
Identification of G. vaginalis

### Table 1

Patterns of results of 72 isolates of possible G. vaginalis

<table>
<thead>
<tr>
<th>Tests</th>
<th>group 1</th>
<th>group 2</th>
<th>group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity tests</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>trimethoprim 5 mg/L</td>
<td>S S S S</td>
<td>S S S S</td>
<td>R R R R</td>
</tr>
<tr>
<td>metronidazole 32 mg/L</td>
<td>S S S R</td>
<td>R R R R</td>
<td>R R R R</td>
</tr>
<tr>
<td>metronidazole 128 mg/L</td>
<td>S S S S</td>
<td>R R R R</td>
<td>R R R R</td>
</tr>
<tr>
<td><strong>Growth on</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium chloride 2% in sensitivity agar</td>
<td>- - - -</td>
<td>- - - -</td>
<td>+ + + +</td>
</tr>
<tr>
<td>Nutrient agar</td>
<td>- - - -</td>
<td>- - - -</td>
<td>+ + + +</td>
</tr>
<tr>
<td><strong>β-Haemolysis on human blood agar</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactic acid from glucose fermentation</td>
<td>- - - -</td>
<td>+ + + +</td>
<td>- - - -</td>
</tr>
<tr>
<td><strong>Number of strains conforming to the pattern</strong></td>
<td>33 3 11 2 3 2 1 2 1 1 5 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S = sensitive, R = resistant; + = positive, — = negative results; w = small zone of haemolysis.

**Identification tests**

**Beta-haemolysis on human blood agar.** Colonies from a 48-h culture of the test organism were inoculated on human-blood agar bi-layer plates (Columbia Agar, Oxoid CM 331, with 10% Proteose Peptone, Difco 0122-01-2, 5% (v/v) human blood and 0-02% (v/v) Tween 80, Atlas Chemical Industries, Ltd). The plates were incubated in an atmosphere of 10% CO2 in air at 37°C for 5 days and examined daily for evidence of β-haemolysis.

**Biochemistry**

(i) **Carbohydrate fermentation.** A modification of Dunkelberg’s medium was the base for carbohydrate fermentation tests (Greenwood and Pickett, 1979). Each test medium was inoculated with a stab of a 48-h culture of the test organism harvested from a blood agar plate. The cultures were incubated in air at 37°C and examined daily for 5 days. Tests for maltose, xylose and sucrose fermentation were repeated to assess reproducibility.

(ii) **Hippurate hydrolysis.** Peptone Yeast Extract (PY) broth was the base for the hippurate hydrolysis test; it contained: Proteose Peptone No. 3 (Difco 0122-01-2) 10g, Yeast Extract (Difco 0127-01-7) 10g, salts solution (component 1) 40ml, haemin solution (component 2) 10ml, vitamin K1 solution (component 3) 0-2ml, cysteine hydrochloride (BDH 1946350) 0-5g; components 2 and 3 and cysteine hydrochloride were added after boiling but before the medium was autoclaved. The components contained: (1) calcium chloride anhydrous (BDH 26224) 0-2g, magnesium sulphate hydrated (BDH 10151) 0-48g, dipotassium hydrogen phosphate (BDH 29619) 1-0g, potassium dihydrogen phosphate (BDH 29608) 1-0g, sodium bicarbonate (Hopkins and Williams, 7882) 10-0g, sodium chloride (Hopkins and Williams 7994) 2-0g; (2) haemin (Koch-Light 2981h) 50mg, ln NaOH (Southern Group Laboratories) 1ml in distilled water 99ml; (3) Vitamin K1 (Sigma V3501) 0-15ml in 95% ethanol 30ml. Tubes of sodium hippurate 1% (w/v) in 3 ml of PY broth (Holdeman, Cato and Moore, 1977) were inoculated with a loopful of a 48-h growth of the test organism harvested from a blood agar plate. The tubes were incubated in an atmosphere of 10% CO2 in air for 5 days. After incubation, 0-5 ml of 50% (v/v) sulphuric acid was added. The presence of white crystalline flakes indicated a positive reaction.

**Gas Chromatography.** The method of analysis of cultures for the production of lactic acid was based on that recommended by Holdeman et al. (1977). A Pye Unicam GCD chromatograph equipped with a flame ionisation detector was used to analyse the samples. A 10-μl volume of the chloroform extract from a methylated 48-h Peptone Yeast Glucose (glucose 1% in PY broth) culture of the test organism was injected into a 1-5m x 0-4mm glass column
which was packed with Chromosorb 101 (Applied Science Labs, Field Instruments Co. Ltd, Queens House, Holly Road, Twickenham, Middlesex.). The following settings were used: column temperature 200°C, injector and detector temperature 240°C and oxygen-free nitrogen carrier gas flow rate 40ml/min. Results were recorded on a Philips 8251 flat-bed recorder. The Pye Unicam GCD chromatograph and the Philips 8251 flat bed recorder were obtained from Pye Unicam Ltd, York Street, Cambridge CB1 2PX.

Enzyme tests. Catalase activity was determined by the method of Cowan (1974). All other enzyme activity was detected by a commercial system, API-ZYM (API Laboratory Products Ltd, Cranbourne Lane, Basingstoke, Hampshire). Tests were performed according to the manufacturers' instructions and were read after incubation for 4 h at 37°C.

Sensitivity to antibiotics and tolerance of chemical inhibitors. Appropriate concentrations of each antibiotic or chemical inhibitor were incorporated in sensitivity agar (Diagnostic Sensitivity Agar, Oxoid CM 261, with 10% (v/v) saponin-lysed defibrinated horse blood). A Denley multi-point inoculator (Denley Instruments Ltd, Billingshurst, Sussex) was used to inoculate the plates with c. 10⁴cfu of each organism. A surface viable count (Miles, Misra and Irwin, 1938) was performed on several strains selected at random to check inoculum size. Cultures were incubated in 10% CO₂ in air for 48 h and examined for growth. No growth or considerably diminished growth in comparison with a control plate was interpreted as sensitivity. Plates containing potassium tellurite were re-incubated for 5 days and examined for blackening in comparison with negative controls.

RESULTS

Provisional grouping

Table I shows 13 different patterns of reactions divided into three clear groups on the basis of trimethoprim sensitivity, lactic acid production from glucose and growth on nutrient agar. All isolates in group 1 were sensitive to trimethoprim, whereas those in groups 2 and 3 were resistant. All isolates in group 2 produced lactic acid from glucose, whereas those in groups 1 and 3 did not, and all isolates in group 3 grew on nutrient agar, whereas those in groups 1 and 2 did not.

Group 1 contained 57 organisms that were identified as G. vaginalis; 83% of these strains produced a diffuse β-haemolysis on human-blood agar, 12% were weakly haemolytic and 5% were non-haemolytic. Ninety-one per cent of group 1 strains were sensitive to metronidazole 128mg/L and 68% were sensitive to metronidazole 32 mg/L. All strains failed to grow in the presence of 2% (w/v) sodium chloride. The four reference strains were found in group 1. Strains V-8821 and V-9477 gave pattern 1 whereas strains NCTC10287 and V-7854 gave pattern 4. Seventy seven per cent of all isolates identified as G. vaginalis gave either pattern 1 or pattern 4, which differed only in sensitivity to metronidazole 32 mg/L. Only two isolates in group 1 differed from the majority by more than one characteristic. These isolates were resistant to metronidazole and produced only weak haemolysis on human-blood agar (pattern 7).

The organisms in group 2 were identified as lactobacilli because all were gram-positive bacilli with no evidence of branching or club-formation and all produced lactic acid from glucose. All were resistant to both concentrations of metronidazole (32 and 128 mg/L) and trimethoprim (5mg/L). Sixty per cent of these lactobacilli grew in the presence of 2% sodium chloride and 40% were haemolytic on human-blood agar.

The organisms in group 3 were identified as catalase-negative coryneforms. They produced only one reaction pattern. All were resistant to both concentrations of
metronidazole, grew in the presence of 2% sodium chloride, and were non-haemolytic on human-blood-agar plates.

Our results with these tests agreed closely with other published results (Smith, 1979; Piot et al., 1980; Wells and Goei, 1981). We concluded that the organisms in groups 1, 2 and 3 could be confidently identified as *G. vaginalis*, *Lactobacillus* spp. and catalase-negative coryneforms respectively and all further analyses of results were based on these groupings.

**Carbohydrate fermentation tests**

Table II shows our results for fermentation tests performed with 22 carbohydrates. All strains of *G. vaginalis*, *Lactobacillus* spp. and catalase-negative coryneforms fermented glucose and ribose and most fermented maltose. Negative reactions were found throughout with cellobiose, lactose, rhamnose, salicin, mannitol, melibiose, dulcitol, glycerol, adonitol, inositol, raffinose and sorbitol. The fermentation reactions with arabinose, galactose, mannose, sorbose, sucrose, fructose and xylose differed within the groups. Three of these carbohydrate fermentation tests were repeated on more than one occasion to test reproducibility. Varying results were recorded for some strains of *G. vaginalis* with all three sugars. Fourteen strains gave inconsistent results for sucrose fermentation (19%), 13 for mannose (18%) and three for xylose fermentation (4%). We concluded that the problem of reproducibility coupled with the fact that some strains within a given species often gave different

### Table II

*Percentage of positive reactions of *G. vaginalis* and related organisms with 22 carbohydrates*

<table>
<thead>
<tr>
<th>Test carbohydrate</th>
<th><em>G. vaginalis</em> (Group 1; 57 strains)</th>
<th><em>Lactobacillus</em> spp. (Group 2; 10 strains)</th>
<th>Catalase-negative coryneforms (Group 3; 5 strains)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adonitol</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arabinose</td>
<td>31</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Cellobiose</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dulcitol</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fructose</td>
<td>95</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Galactose</td>
<td>33</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>Glucose</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Glycerol</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inositol</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lactose</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maltose</td>
<td>93</td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td>Mannitol</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mannose</td>
<td>40</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>Melibiose</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Raffinose</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rhamnose</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ribose</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Salicin</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sorbitol</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sorbose</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Sucrose</td>
<td>62</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Xylose</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>
reactions and that some strains of different species gave the same reactions rendered carbohydrate fermentation tests of little value in the identification of *G. vaginalis* and related organisms.

**Enzyme activity**

Table III shows the results of enzymic activity determined with 21 substrates. All strains of *G. vaginalis*, *Lactobacillus* spp. and catalase-negative coryneforms gave positive reactions for esterase (C4), esterase lipase and α-glucosidase activity but negative reactions were found for lipase (C14), valine arylamidase, trypsin, chymotrypsin, α-galactosidase, β-glucuronidase and α-fucosidase activity. Alkaline phosphatase, leucine arylamidase, cystine arylamidase, acid phosphatase, phosphoamidase, β-galactosidase, β-glucosidase, N-acetyl-β-glucosaminidase and α-mannosidase activity differed in incidence within the groups, but these results were of little help in the differentiation of *G. vaginalis* from catalase-negative coryneforms and lactobacilli. All isolates, except one lactobacillus, hydrolysed hippurate.

**Tolerance of chemical inhibitors and sensitivity to antibiotics**

Table IV shows the percentage of *G. vaginalis* and catalase-negative coryneforms found tolerant of or sensitive to a selection of chemicals and antibiotics. All strains of...
G. vaginalis were inhibited by tetrazolium salt 0.01% (w/v), 93% were inhibited by phenol 0.1% (w/v) and 71% by bile 0.5% (w/v). In contrast all strains of catalase-negative coryneforms although inhibited by tetrazolium salt 0.01% (w/v), grew in the presence of bile 0.5% (w/v) and only 20% were inhibited by phenol 0.1% (w/v). Lactobacilli were also inhibited by tetrazolium salt 0.01% (w/v), but only 50% grew on bile 0.5% (w/v) and 70% were inhibited by phenol 0.1% (w/v). All isolates, except one lactobacillus, tolerated potassium tellurite 0.001% (w/v).

All isolates were sensitive to nitrofurantoin, novobiocin and vancomycin. Ninety per cent of strains of G. vaginalis were sensitive to streptomycin 6 mg/L and 43% to tetracycline 0.5 mg/L, whereas 40% of catalase-negative coryneforms and 20% of lactobacilli were sensitive to streptomycin and tetracycline. None of the groups had a characteristic pattern of inhibition by these substances.

**DISCUSSION**

We examined a variety of simple techniques in this study in an attempt to develop an identification system for G. vaginalis that could be useful in a diagnostic laboratory. Although the techniques we used all showed varying degrees of difficulty in interpretation and reproducibility, we found a combination of seven tests of particular value for distinguishing G. vaginalis from other catalase-negative coccobacilli isolated from the vagina. Each of these tests is relatively easy to perform, interpret and reproduce and could be used in a routine laboratory for the identification of G. vaginalis by following the scheme outlined in table V.

We found, in general agreement with Piot et al. (1980), that G. vaginalis was invariably sensitive to trimethoprim 5 mg/L, that most strains were inhibited by metronidazole 128 mg/L, and that only two thirds were sensitive to metronidazole 32
mg/L. In our hands, catalase-negative coryneforms and lactobacilli were resistant to both trimethoprim and metronidazole, although Piot reported that 37% of his strains of catalase-negative coryneforms were sensitive to metronidazole 128 mg/L.

We found, as did Piot, that *G. vaginalis* was inhibited by sodium chloride 2% (w/v) whereas the catalase-negative coryneforms were resistant and that *G. vaginalis* did not grow on nutrient agar whereas the catalase-negative coryneforms did. The lactobacilli that we tested did not grow on nutrient agar and 40% failed to grow in the presence of sodium chloride 2% (w/v). These tests appear particularly useful as they are easy to perform and could be used in a diagnostic laboratory. However, batch variation in commercial media, particularly nutrient agar, may make these results difficult to reproduce in practice.

*β*-Haemolysis of human blood has been suggested as a means of rapid identification of *G. vaginalis* (Smith, 1979; Wells and Goei 1981; Totten et al., 1982). We found that although 95% of *G. vaginalis* strains produced *β*-haemolysis on human-blood agar, some lactobacilli did the same. Piot et al. (1980) reported that 60% of *Lactobacillus acidophilus* and 43% of *Streptococcus* spp. produced *β*-haemolysis on human-blood agar and commented on several difficulties in interpretation of positive results. Smith (1979) also reported that some lactobacilli and streptococci produced a haemolysis that could be confused with that of *G. vaginalis*. We are unable to comment on haemolysis by streptococci on human-blood agar as there were none in our series. However, we found that the degree of haemolysis varied considerably between strains of *G. vaginalis* and that results were occasionally difficult to interpret. Totten et al. (1982) reported that the addition of Tween 80 0.02% (v/v) to a 7% (v/v) human-blood bilayer agar plate enhanced the zone of haemolysis. We would agree that this is an improvement on the original medium, but still found some results difficult to interpret.

Most previously proposed diagnostic systems have been based on carbohydrate fermentation tests. In our hands these tests were often poorly reproducible, and even
those that gave reproducible results were of little value as other closely related organisms usually gave the same reactions as G. vaginalis. We encountered problems of reproducibility with sucrose, xylose and mannose, a phenomenon that has been described previously (Bailey et al., 1979; Greenwood and Pickett, 1979). We believe that variation in the quality of growth media may be responsible for this. However, although Piot et al. (1980) used a closely-defined growth medium for carbohydrate fermentation tests they still encountered difficulties. We therefore concluded that carbohydrate fermentation, as tested by us, was of little value.

We considered the commercial API-ZYM system. Many of our results differed quite considerably from those of Piot et al. (1980). In our hands, more than 95% of G. vaginalis had esterase (C4), esterase lipase and phosphoamidase, whereas Piot found that only 21% had esterase (C4), 31% esterase lipase and 7% phosphoamidase. These differences may be explained by batch variation in the commercial product, differences of interpretation, or differences in the bacterial populations studied. We believe that problems of interpretation may contribute, as a weak reaction is often difficult to interpret in the API-ZYM system and if this is the case it seems unlikely that this system of enzyme detection could be used for the identification of G. vaginalis in the diagnostic laboratory.

Only 7% of the strains of G. vaginalis examined in this study were tolerant of phenol 0.1% (w/v) compared with 80% of the catalase-negative coryneforms and 30% of lactobacilli. These findings are similar to those of Piot et al. (1980) which suggests that this test may be of value. Piot, however, found the test poorly reproducible, although we did not.

Our results for potassium tellurite tolerance differed quite considerably from those of others and we assume that this also results from problems of reproducibility (Smith, Voss and Bailey, 1977; Piot et al., 1980). Similarly, our results for tetrazolium tolerance contrasted slightly with those of Piot. Our results for bile tolerance agreed with those of Piot but both contrasted with those of Dunkelberg et al. (1970), who reported that all their strains were inhibited by bile 0.5% (w/v). Bile is an ill-defined ingredient and batch variation may explain these discrepancies.

Similar problems of reproducibility were also encountered in sensitivity testing. Our results for nitrofurantoin sensitivity are similar to those of Piot, but all our strains, were sensitive to novobiocin 2 mg/L and vancomycin 5 mg/L, whereas Piot reported that only 34% of G. vaginalis were sensitive to novobiocin 2 mg/L. Our results for streptomycin and tetracycline sensitivity are similar to those of other study groups (Ralph et al., 1979; Piot et al., 1980), except that we found that 60% of catalase-negative coryneforms were resistant to tetracycline, whereas Piot reported resistance in only 16% of his isolates. We concluded that sensitivity testing with these antibiotics was unlikely to be useful for identification purposes. However it should be noted that only a small number of isolates was examined in each series.

Our conclusions from this study are that a presumptive identification of G. vaginalis in cultures of vaginal discharge based on its appearance on blood agar and variable reaction with Gram's stain would prove correct in c. 80% of cases, but that more accurate identification of G. vaginalis is made difficult by problems of reproducibility. However, seven tests that were relatively easy to perform and interpret and that gave results comparable with those of previous publications were used successfully in this study to identify G. vaginalis. Of these, we would suggest that
β-haemolysis on human-blood agar together with sensitivity to trimethoprim and a high concentration of metronidazole are most likely to provide an accurate and rapid identification.

REFERENCES


