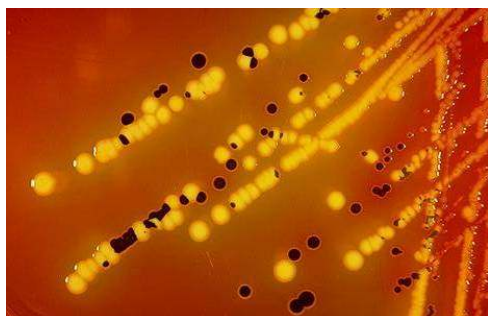


## XLD AGAR

### Ready-to-use plates



XLD Agar: *Salmonella* colonies with large black centre and *E. aerogenes* with yellow colonies

#### 1 - INTENDED USE

*In vitro* diagnostic. Selective and differential medium for the isolation of Gram-negative enteric pathogens, especially *Salmonella* and *Shigella*, from clinical and non clinical specimens.

#### 2 - COMPOSITION - TYPICAL FORMULA \*

Xylose	3.50 g	Sodium deoxycholate	2.50 g
L-lysine	5.00 g	Sodium thiosulphate	6.80 g
Lactose	7.50 g	Ferric ammonium citrate	0.80 g
Sucrose	7.50 g	Phenol red	0.08 g
Sodium chloride	5.00 g	Agar	13.50 g
Yeast extract	3.00 g	Purified water	1000 mL

\*The formula may be adjusted and/or supplemented to meet the required performances criteria.

#### 3 - PRINCIPLE OF THE METHOD AND EXPLANATION OF THE PROCEDURE

In the first half of the twentieth century, several culture media were developed and proposed for the isolation of enteric pathogens from faeces and other materials. Some of them were moderately selective and allowed the growth of faecal contaminants, others showed excessive toxicity for the growth of pathogens, especially of *Shigella*.<sup>1</sup> In 1965, xylose lysine deoxycholate (XLD) agar was introduced by Welton I. Taylor for the enhanced recovery of *Shigella*.<sup>2</sup> Several clinical evaluations demonstrated the relatively high efficiency of XLD Agar in the primary isolation of *Shigella* and *Salmonella*.<sup>3-5</sup>

XLD Agar is a selective and differential medium intended for the isolation of Gram-negative enteric pathogens, especially *Salmonella* and *Shigella* from clinical specimens.<sup>6-8</sup> It is recommended for the detection of *Salmonella* in non-sterile pharmaceutical products according to harmonized EP, USP, JP method<sup>9</sup> and by FDA-BAM for detection of *Salmonella* in food<sup>10</sup>. The XLD formula recommended by ISO norms for the detection of *Salmonella* and *Shigella* in food and water contains a lower concentration of sodium deoxycholate and corresponds to Biolife medium XLD Agar ISO Formulation.

Yeast extract provides carbon, nitrogen, vitamins and trace elements for bacterial growth; sodium chloride maintains the osmotic balance in the medium; sodium deoxycholate is a selective agent for suppressing the growth of Gram-positive bacteria. XLD Agar contains three indicator systems: xylose, lactose, and sucrose combined with phenol red, lysine hydrochloride and again phenol red, sodium thiosulfate and ferric ammonium citrate. Target bacteria are tentatively grouped by reading the effect of carbohydrate fermentation, lysine decarboxylation and formation of hydrogen sulphide.

Sugars' fermentation lowers the pH and the phenol red indicator registers this by changing from red to yellow. Most enteric bacteria, including *Salmonella*, can ferment the xylose to produce acid; *Shigella* does not ferment the xylose, does not cause acidification of the medium, and therefore, grows with red colonies. After exhausting the xylose supply, *Salmonella* colonies will decarboxylate lysine, increasing the pH once again to alkaline and mimicking the red *Shigella* colonies. To prevent similar pH reversion by lysine-positive coliforms, lactose and sucrose are added to produce acid in excess. Moreover *Salmonella* spp. produce thiosulphate reductase that cause the release of a sulphide molecule from the sodium thiosulfate present in the medium; this sulphide molecule couples with a hydrogen ion to form H<sub>2</sub>S gas that reacts with the ferric ammonium citrate, forming a precipitate, resulting in colonies that are black or have a black centre.

#### 4 - PHYSICAL CHARACTERISTICS

Medium appearance	red orange, limpid
Final pH at 20-25 °C	7.4 ± 0.2

#### 5 - MATERIALS PROVIDED - PACKAGING

Product	Type	REF	Pack
XLD Agar	Ready-to-use plates	542206	2 x 10 plates ø 90 mm primary packaging: 2 cellophane sachets secondary packaging: cardboard box

#### 6 - MATERIALS REQUIRED BUT NOT PROVIDED

Sterile loops and swabs, incubator and laboratory equipment as required, ancillary culture media and reagents for the identification of the colonies.

#### 7 - SPECIMENS

XLD Agar is intended for the bacteriological processing of clinical specimens such as faeces, rectal swab, urine, bile,<sup>6-8</sup> on sterile pharmaceutical products<sup>9</sup> and food<sup>10</sup>. Collect specimens before antimicrobial therapy where possible. Good laboratory practices for collection, transport and storage of clinical specimens should be applied.<sup>11</sup> Consult appropriate standard methods for details of collection and preparation of non-clinical specimens.<sup>9,10</sup>

#### 8 - TEST PROCEDURE

Allow plates to come to room temperature and to dry the surface of the medium.

Inoculate and streak the specimen with a loop over the four quadrants of the plate to obtain well isolated colonies, ensuring that sections 1 and 4 do not overlap. Alternatively, if the material is being cultured directly from a swab, roll the swab over a small area of the surface at the edge; then streak from this inoculated area.

Maximal recovery of *Salmonella* from faecal specimens is obtained by using the enrichment step in Selenite Broth followed by subculture to XLD Agar and to a second plating medium.<sup>8</sup>

For *Shigella* isolation from faecal specimens, the enrichment in GN Broth is advised, followed by subculture on two different selective media: XLD Agar and a second less selective medium (Mac Conkey Agar).<sup>8</sup>





Incubate inoculated XLD Agar plates with the specimen or with a specimen enriched in liquid medium, in aerobic conditions at 35-37°C for 18-24 hours. Colonies on XLD agar may require 48 hours incubation for full colour and black precipitate development.

For the detection of *Salmonella* in non-sterile pharmaceuticals products the technique recommended by European Pharmacopoeia<sup>9</sup>, and summarized below, should be followed:

- Prepare a sample using a 1:10 dilution of not less than 1 g of the product to be examined and use 10 mL or the quantity corresponding to 1 g or 1 mL to inoculate the suitable amount of Tryptic Soy Broth. Mix and incubate at 30-35°C for 18-24 h.
  - Shake the container, transfer 0,1 mL of Tryptic Soy Broth to 10 mL of Rappaport Vassiliadis Enrichment Salmonella Broth EP (REF 401979) and incubate at 30-35°C for 18-24 h.
  - Subculture on a plate of XLD Agar and incubate at 30-35 °C for 18-48 h.
- Consult appropriate references for the detection of *Salmonella* in food.<sup>10</sup>

### 9 - READING AND INTERPRETATION

After incubation, observe the bacterial growth and record the specific morphological and chromatic characteristics of isolated colonies. Do not examine areas of confluent growth as false negative fermentation reactions may occur.

Interpretation of colonies' colours<sup>12</sup>:

**Red colonies:** alkaline reaction, non-fermentation of xylose/sucrose/lactose, or fermentation of xylose followed by decarboxylation of lysine: possible *Shigella* or *Providencia* or *Pseudomonas* spp. or *Salmonella* sp. H<sub>2</sub>S negative

**Red colonies with black centre:** xylose fermentation only, lysine positive, H<sub>2</sub>S positive, rapid depletion of xylose and resultant alkalinity due to lysine decarboxylation, black centre due to H<sub>2</sub>S production possible only in alkaline pH environment: suspect *Salmonella* H<sub>2</sub>S positive.

**Opaque yellow colonies:** xylose fermentation, lysine negative and non-fermentation of lactose and sucrose, acid pH: possible *E. coli*, *Klebsiella/Enterobacter*, *Citrobacter*, *Serratia*, *Proteus* spp.

**Yellow colonies:** lactose or sucrose fermentation, lysine negative, acid pH: possible coliforms or sucrose-positive *P. vulgaris*

For presumptive *Salmonella* spp. identification, it is advised to screen the colonies by testing the colonies with one drop of MUCAP reagent (REF 191500) and observing after 3 to 5 min for the development of fluorescence under Wood's lamp, produced in the presence of the C<sub>8</sub> esterase enzyme, typical of *Salmonella* spp.<sup>14</sup>

### 10 - USER QUALITY CONTROL

All manufactured lots of the product are released for sale after the Quality Control has been performed to check the compliance with the specifications. However, it is responsibility of the end-user to perform Quality Control testing in accordance with the local applicable regulations, in compliance with accreditation requirements and the experience of the Laboratory. Here below are listed some test strains useful for the quality control.<sup>13</sup>

CONTROL STRAINS	ATCC	INCUBATION T° / T / ATM	EXPECTED RESULTS
<i>S. Typhimurium</i>	ATCC 14028	30-35 or 35-37°C / 18-24h / A	growth, red colonies with black centre
<i>S. flexneri</i>	ATCC 12022	30-35 or 35-37°C / 18-24h / A	growth, red colonies
<i>E. faecalis</i>	ATCC 29212	30-35 or 35-37°C / 18-24h / A	inhibited
<i>E. coli</i>	ATCC 25922	30-35 or 35-37°C / 18-24h / A	partially inhibited, yellow colonies

A: aerobic incubation; ATCC is a trademark of American Type Culture Collection  
Incubation temperature depends of the followed Standard (CLSI<sup>13</sup> or EuPh<sup>7</sup>)

### 11 - PERFORMANCES CHARACTERISTICS

Prior to release for sale a representative sample of all lots of ready to use plates of XLD Agar and of the raw material used for the production of prepared plates (dehydrated XLD Agar REF 402206) are tested for productivity and selectivity by comparing the results with a previously approved Reference Batch.

Productivity is tested by a quantitative test with 2 target strains: *S. Enteritidis* ATCC 13076, *S. Typhimurium* ATCC 14028; XLD Agar plates are inoculated with decimal dilutions in saline of the colonies' suspensions and incubated at 30-35°C for 18-24 hours. The colonies are enumerated on both batches and the productivity ratio (*Pr*) is calculated. If *Pr* is ≥ 0,7 and if the colonies morphology and colour are typical (red colonies with black centre) the results are considered acceptable and conform to the specifications. Furthermore, the productivity characteristics are tested by semi-quantitative ecometric technique with the target strain *S. flexneri* ATCC 12022. After incubation, colonies' colour and the amount of growth is evaluated and recorded.

Selectivity is evaluated with modified Miles-Misra surface drop method by inoculating the plates with decimal dilutions in saline from 10<sup>-1</sup> to 10<sup>-3</sup> of a 0.5 McFarland suspension of the non-target strains *E. faecalis* ATCC 19433 and *E. coli* ATCC 25922. The growth of non-target strain *E. faecalis* is inhibited at the dilution 10<sup>-1</sup>, the growth of Gram-negative non-target strain is partially inhibited and the colonies show typical yellow colour, according to the specifications.

Accuracy was assessed by reviewing the Quality Control data. The results of 33 batches produced from 1/1/2019 to 18/5/2020 were evaluated. 100% of the batches showed conformity to defined acceptance criteria in terms of productivity and differential properties with target strains and selectivity with non-target strains.

### 12 - LIMITATIONS OF THE METHOD

- A single medium is only rarely useful to recover all pathogens contained in a specimen. Therefore, additional media for the isolation of *Salmonella* and/or *Shigella*, with lower selectivity such as Mac Conkey Agar and with higher selectivity such as SS Agar, should be used; it is suggested to inoculate additional media for the isolation of other enteric pathogens with the specimen.<sup>8</sup>
- Non-enteric organisms such as *Pseudomonas* may grow; *Pseudomonas* and *Providencia rettgeri* may both exhibit red colonies. Some *Proteus* spp. may develop black centres.<sup>12</sup>
- *S. Paratyphi* A, *S. Cholerae-suis*, *S. Pullorum* and *S. Gallinarum* may form red colonies without black centre, thus resembling *Shigella* spp.
- Incubation exceeding 48 hours may lead to false positive results.<sup>12</sup>
- The device is not intended to diagnose gastro-intestinal infections or to guide the antimicrobial therapy. It is used in a diagnostic set of investigations to provide microbial colonies isolated from clinical samples of patients with suspected *Salmonella-Shigella* infection. Appropriate tests are required for complete identification and epidemiological typing of colonies; if necessary, perform antimicrobial susceptibility tests using recommended methods.



**13 - PRECAUTIONS AND WARNINGS**

- This product is a qualitative *in vitro* diagnostic device intended for professional use only, is not automated and is not a companion diagnostic tool. It must be used by adequately trained and qualified laboratory personnel, observing biohazard precautions and aseptic techniques.
- This product is not classified as dangerous according to current European legislation.
- This culture medium contains raw materials of animal origin. Therefore, it is recommended that the ready-to-use plates be treated as potentially infectious, and handled observing the usual specific precautions: do not ingest, inhale, or allow to come into contact with skin, eyes, mucous membranes. Download the TSE Statement from the website [www.biolifeitaliana.it](http://www.biolifeitaliana.it), describing the measures implemented for the risk reduction linked to infectious animal diseases.
- All laboratory specimens should be considered infectious.
- The laboratory area must be controlled to avoid contaminants such as culture medium or microbial agents.
- Each plate of this culture medium is for single use only.
- Ready-to-use plates are not to be considered a "sterile product" as they are not subject to terminal sterilization, but a product with controlled bio contamination, within the limits of defined specifications reported on the Quality Control Certificate.
- Sterilize all biohazard waste before disposal and dispose of the unused medium and the sterilized plates inoculated with samples or microbial strains, in accordance with current local legislation.
- The Certificates of Analysis and the Safety Data Sheet of the product are available on the website [www.biolifeitaliana.it](http://www.biolifeitaliana.it).
- Notify the Manufacturer ([complaint@biolifeitaliana.it](mailto:complaint@biolifeitaliana.it)) and the relevant Authorities of any serious incident occurring in connection with the use of the *in vitro* diagnostics.
- The Manufacturer may not be held responsible for any loss or damage in any way resulting from or related to use of the product in manners not compliant with the instructions provided.















**14 - STORAGE CONDITIONS AND SHELF LIFE**

Upon receipt, store plates in their original pack at 2-8°C away from direct light. If properly stored, the plates may be used up to the expiration date. Do not use the plates beyond this date. Plates from opened plastic sachet can be used for 7 days when stored in a clean area at 2-8°C. Do not use the plates if the plastic sachet is damaged or if the dish is broken. Do not use the plates with signs of deterioration (e.g. microbial contamination, dehydration, shrinking or cracking of the medium, atypical colour, excess of moisture).

**15 - REFERENCES**

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**TABLE OF APPLICABLE SYMBOLS**

 Catalogue number	 Batch code	 <i>In vitro</i> diagnostic medical device	 Manufacturer	 This way up	 For single use only	 European conformity mark
 Temperature limitations	 Contents sufficient for <n> tests	 Consult electronic instructions for use	 Use by	 Keep away from sunlight	 Fragile, handle with care	 Unique device identifier

**REVISION HISTORY**

Version	Description of changes	Date
Revision 2	Updated layout and content in compliance with IVDR 2017/746	2020/05
Revision 3	Removal of obsolete classification	2023/03
Revision 4	Performances characteristics, limitation of the method, precautions and warnings, table of applicable symbols.	2025/11

Note: minor typographical, grammatical, and formatting changes are not included in the revision history.

