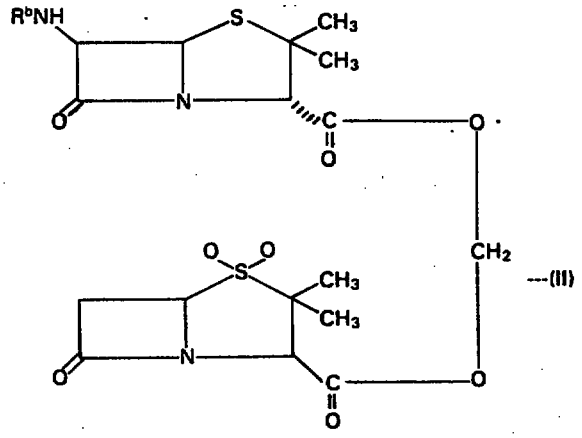
Description

The invention relates to certain novel benzenesulfonic acid addition salts of 1,1-dioxopenicillanoyloxymethyl 6-[D-(2-amino-2-phenylacetamido)]penicillanate (sultamicillin) having advantages for use in antibacterial formulations.

Barth, in U.S. 4 234 579 issued November 18, 1980, discloses penicillanic acid 1,1-dioxide (sulbactam) and esters thereof which are readily hydrolyzable in vivo, useful as antibacterial agents and for enhancing the effectiveness of beta-lactam antibiotics, such as ampicillin, against many beta-lactamase producing bacteria.

Bigham, in U.S. 4 244 951 issued January 13, 1981; and Netherland Patent Application No. 8 000 775 published August 15, 1980, corresponding to Britisch Patent Application No. 2 044 255, both disclose novel conjugates of penicillanic acid 1,1-dioxide with known penicillin antibiotics which are linked via a methylenedioxy group. These conjugates are of the general formula



---(II)

wherein R^b is the acyl group of a natural or semisynthetic penicillin.

The compound of the above formula wherein R^b is D-(2-amino-2-phenylacetyl) is designated herein as «sultamicillin» and will be referred to herein by that name. It is a methylenedioxy linked conjugate of penicillanic acid 1,1-dioxide and ampicillin.

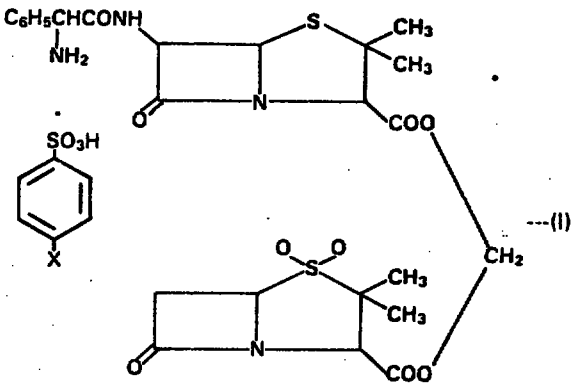
Sultamicillin free base has been found to have poor handling characteristics and inadequate stability. The only salt of sultamicillin specifically disclosed in the art is the hydrochloride. While it is suitable for certain antibacterial formulations, it also has poor solid state stability, which is reflected in handling difficulties, and is highly soluble in water in which it is subject to hydrolytic decomposition. Thus, it is unsuitable for aqueous dosage formulations, including the aqueous suspensions preferred in pediatric medicine.

Crystalline forms of compounds are ordinarily preferable to the non-crystalline forms thereof. The crystalline materials have superior stability, appearance and handling characteristics when compared to their amorphous counterparts. For pharmaceutical use crystalline compounds are especially advantageous in manufacturing procedures and in formation and use of acceptable dosage forms such as solutions, suspensions, elixirs, tablets, capsules and various pharmaceutically elegant preparations required by the medical and pharmaceutical professions.

For pediatric administration it is well recognized by those of skill in the art that solutions or liquid suspensions are highly preferable dosage forms. Tablets and capsules are difficult for children to swallow and the amount of drug delivered is not as flexible as is often required for pediatric drugs. With liquid dosage forms, by contrast, the amount of drug delivered to the patient can be varied over a wide range merely by regulating the volume of dose of known concentrations.

Conjugate antibiotics such as sultamicillin are susceptible to partial hydrolysis to its components (ampicillin and sulbactam) upon storage in aqueous media. Thus, the enhanced stability in aqueous suspensions of a salt of sultamicillin of limited solubility, relative to another salt of significantly higher solubility, such as the hydrochloride, is evident.

The invention relates to certain benzenesulfonic acid addition salts of sultamicillin of the formula



---(I)

and hydrated forms thereof, where X is hydrogen or chloro. Especially preferred salts of formula (I) are the crystalline dihydrates. These crystalline salts have advantages over prior art forms of sultamicillin and other salts of this conjugate antibacterial agent. The crystalline dihydrate salts of the invention have excellent pharmacokinetic properties, near optimal solubility in aqueous systems and improved stability in bulk and in aqueous suspensions. As a result of these features, the crystalline salts of the invention offer valuable advantages in manufacture of various dosage forms, particularly pediatric dosage forms, and in improving product stability.

The invention also provides the anhydrous and other hydrated forms of the same salts of formula (I) which serve as precursors of the more desirable crystalline dihydrates.

The invention also provides pharmaceutical compostions suitable for treating a bacterial infection in a mammalian subject comprising an antibacterially effective amount of a crystalline dihydrate salt of the invention and a pharmaceutically acceptable carrier. Particularly preferred such compositions are those suitable of use in pediatric medicine.

The salts of formula (I) are prepared by standard methods known in the art for preparing acid addition

salts of aminopenicillins. For example, they are obtained by contacting the free base of sultamicillin, or an acid addition salt thereof, with an equimolar amount of the appropriate acid, i.e., benzenesulfonic acid of 4-chlorobenzenesulfonic acid in the presence of a suitable solvent. By the term «suitable solvent» is meant a solvent that will not appreciably react with the reactants or product, under the conditions employed, except to form a solvate, will dissolve or partially dissolve the reactants at or about room temperature and will allow precipitation of the product salt at room temperature or below, or upon addition of a non-solvent. Examples of suitable solvents include ethyl acetate, methanol, ethanol, butanol, acetone, methylethyl ketone, tetrahydrofuran, water and mixtures thereof. The sultamicillin free base can be obtained, e.g., by methods described in U.S. 4 244 951 and Great Britain Patent Application No. 2 044 255. The starting benzenesulfonic acids are readily available in commerce.

The compounds of formula (I) can also be preparad by metathesis of salt forms in which an inorganic salt is formed, for example, by reaction of a hydrohalide addition salt of sultamicillin with an alkali metal or alkaline earth salt of the appropriate sulfonic acid. In a preferred such reaction, sultamicillin hydrochloride is reacted with sodium benzenesulfonate or sodium 4-chlorobenzenesulfonate in water, from which the particularly preferred crystalline dihydrate salt of formula (I) is precipitated and, if desired further purified, e.g. by recrystallisation.

A further method for forming the instant salts of formula (I) is by reaction of an amino-protected precursor of sultamicillin in the presence of the requisite benzenesulfonic acid or 4-chlorobenzenesulfonic acid under conditions which both remove the amino-protecting group and allow salt formation. In a preferred such reaction an enamine-protected precursor of sultamicillin, e.g. 1,1-dioxopenicillanoyloxymethyl 6-[D-(2-[1-methyl-2-methoxycarbonylvinylamino]-2-phenylacetamido)]penicillanate is contacted with an equimolar amount of benzenesulfonic acid or 4-chlorobenzenesulfonic acid in the presence of a polar organic solvent, e.g., ethyl acetate, and water. Under these conditions and at or about room temperature, the enamine protecting group is removed, the desired salt is formed and it precipitates from solution, ordinarily as the crystalline dihydrate.

When salt formation is carried out under anhydrous conditions, the product formed is an anhydrous compound of formula (I). When the amount of water used is less than that needed to form the dihydrate mixtures of the anhydrous, monohydrate and dihydrate forms are produced. The anhydrous salts and monohydrates of formula (I) are useful as intermediates leading to the more stable dihydrates upon exposure to moisture.

The crystalline dihydrate salts of the invention have advantageous properties which make them particularly useful as orally administered antibacterial agents. They allow rapid adsorption from the gastrointestinal tract. During or subsequent to absorption, in vivo ester hydrolysis occurs with liberation of ampicillin and the beta-lactamase inhibitor, penicillanic acid 1,1-dioxide (sulbactam). These salts have relatively low, yet adequate, solubility in aqueous systems, resulting in improved stability of aqueous oral dosage forms, such as the oral suspensions preferred in pediatric medicine.

Pharmacokinetic Studies

Upon oral administration to laboratory animals the crystalline invention compounds and the hydrochloride salt are each found to have excellent pharmacokinetic properties. The results of such a study conducted in rats is summarized in Table I, below. The data shows that each of the three salts are rapidly absorbed and hydrolized upon oral administration to produce high serum levels of both ampicillin and the beta-lactamase inhibitor, sulbactam. The differences between the three salts summarized in Table I are found to be not significant, statistically.

Table I

Pharmacokinetic Data After Oral Administration of 20 mg./kg. of Sultamicillin Salt to Rats

	Serum Concentration (μg./ml.)					
Sample	Hydrochloride Salt		$C_6H_5SO_3H \cdot 2H_2O$ Salt		$4\text{-}ClC_6H_4SO_3H \cdot 2H_2O$ Salt	
Time, Hr.	Ampicillin	Sulbactam	Ampicillin	Sulbactam	Ampicillin	Sulbactam
0.25	1.74±0.15	1.51±0.27	1.77±0.17	1.15±0.13	2.65±0.26	2.21±0.32
0.5	1.99±0.17	2.15±0.30	2.25±0.16	1.47±0.20	2.88±0.03	2.29±0.24
1	1.39±0.12	1.46±0.12	1.31±0.07	1.00±0.11	1.47±0.18	1.13±0.12
1.5	0.87±0.11	1.00±0.16	0.80±0.01	0.67±0.11	0.81±0.07	0.73±0.05
2	0.5 ±0.07	0.71±0.13	0.55±0.03	0.49±0.07	0.39±0.06	0.39±0.03
3	0.25±0.04	0.42±0.08	0.26±0.02	0.34±0.05	0.15±0.03	0.16±0.03
4	0.13±0.02	0.17±0.04	0.15±0.01	0.22±0.02	0.06±0.007	0.08±0.01
Area Under Serum Curve, μg./ml. hr.	3.19	3.96	3.28	2.91	3.42	2.92
T 1/2 Beta-phase, hr.	0.87	1.18	0.91	1.26	0.63	0.73

The above data was obtained employing 80-100 g. out-bred Sprague-Dawley rats. The compounds are administered orally (5 rats per compound) as an aqueous suspension, 0.5 ml., containing 20 mg./kg. of the drug.

Blood samples are taken at the indicated times and subjected to differential bioassay to determine the ampicillin and sulbactam levels. The ampicillin bioassay makes use of Sarcina lutea (ATCC 9341) which is susceptible to ampicillin but insensitive to sulbactam at concentrations as high as 100 µg./ml., since it does not contain a beta-lactamase. Thus, this organism fails to show synergy with combinations of ampicillin and sulbactam. A standard curve is prepared in normal serum at ampicillin levels of 4, 2, 1, 0.5, 0.25 and 0.125 µg.ml. Sterile filter paper discs are loaded with 25 lambda volumes. Assay plates are prepared using seed agar (Difco). An overnight culture of Sarcina lutea is diluted 1 : 100 and 1 ml. of this dilution is added to 100 ml. of the agar in 12/12" plastic plates. The plates are then incubated at 37°C. for 18 hours, and the zones measured.

The sulbactam determination is based on the insensitivity of Pasteurella histolytica (59B010) to high concentrations of either ampicillin or sulbactam, alone. However, since its resistance is mediated via a beta-lactamase, the culture responds synergistically to combinations of ampicillin and sulbactam. A standard curve is prepared in a manner analogous to that described above for ampicillin. Assay plates are prepared by adding 1 ml. of an overnight culture of Pasteurella histolytica to 100 ml, of Mueller-Hinton agar that has been adjuncted with 50 µg./ml. ampicillin and 5% sterile bovine blood. The plates are incubated at 37°C. for about 18 hours after which the zones are measured.

Solubility

The solubility of the salts in water and simulated gastric juice without pepsin (pH 1.2) were compared. Equilibrium solubility was not determined since the compounds are not entirely stable in aqueous systems for the extended time required to reach equilibrium. Therefore, the apparent solubility was determined by vigorous agitation for 30 minutes with the solvent. The resulting mixture was then filtered and the amount of compound in solution determined by high pressure liquid chromatography (HPLC). The results are summarized in Table II.

Table II

Apparent Solubility of Sultamicillin Salts in Water and Simulated Gastric Juice (Without Pepsin, pH 1.2)

	Apparent Solubility, mg/ml			
Salt	Water	(Final pH)	Simulated Gastric Juice	(Final pH)
Hydrochloride	>94	(2.0)	>79	(1.12)
Benzenesulfonate . $2H_2O$*	2.15	(3.4)	1.8	(2.0)
4-Chlorobenzenesulfonate . $2H_2O$*	3.3	(3.8)	6.3	(1.1)

* crystalline

Crystallinity

X-ray powder diffraction patterns were obtained on a Siemens diffractometer equipped with copper radiation and a scintillation counter detector. Beam intensity as a function of the angle 2 theta was recorded at a scanning rate of 2° per minute. The crystallinity of sultamicillin benzenesulfonate dihydrate and sultamicillin 4-chlorobenzenesulfonate dihydrate were verified by a multiplicity of peaks in the x-ray powder diffraction patterns for these salts.

Stability

Upon storage of samples of the three salts at 50°C. for three weeks the crystalline benzenesulfonate·$2H_2O$ and 4-chlorobenzenesulfonate·$2H_2O$ were found to have retained 97% and 100% of their potency, respectively. The hydrochloride salt retained only 67% of its original potency under these conditions.

High Pressure Liquid Chromatography (HPLC)

In the solubility and stability studies above samples of the materials were assayed by HPLC using a Chromegabond C-8* column (4.6 mm internal diameter × 30 cm). The mobile phase consisted of 30% by weight acetonitrile in pH 3 phosphate buffer (0.1 M). Flow rate, 1.6 ml/minute. Detection was by UV at 230 nm.

When using an antibacterial salt of this invention in a mammal, particularly man, the compound can be administered alone, or it can be mixed with other antibiotic substances and/or pharmaceutically-acceptable carrriers or diluents. Said carrier or diluent is chosen on the basis of the intended mode of administration. For example, when considering the oral mode of administration, an antibacterial compound of this invention can be used in the form of tablets, capsules, lozenges, troches, powders, syrups, elixirs, aqueous solutions and suspensions, and the like, in accordance with standard pharmaceutical practice. The proportional ratio of active ingredient to carrier will naturally depend on the chemical nature, solubility and stability of the active ingredient, as as well as the dosage contemplated. In the case of tablets for oral use, carriers which are commonly used include lactose, sodium citrate and salts of phosphoric acid. Various disintegrants such as starch, and lubricating agents, such as magnesium stearate, sodium lauryl sulfate and talc, are commonly used in tablets. For oral administration in capsule form, useful diluents are lactose and high molecular weight polyethylene glycols, e.g. polyethylene glycols having molecular weight of from 2000 to 4000.

Because of the advantageous solubility and stability of the crystalline sultamicillin benzenesulfonate dihydrate salts of the invention, a particularly preferred mode of administration for use with children is orally via an aqueous suspension. For preparing such suspensions the crystalline dihydrate of formula (I) can be combined with buffers, emulsifying and suspending agents. If desired, certain sweetening and/or flavoring agents can be added. The result-

* A trademark of ES Industries.

ing suspension can be stored in the presence of water, especially if refrigerated, for considerable periods. However, a preferred method is to store the mixture as a dry powder until its use is required, at which time it is mixed with an appropriate diluent, e.g., water.

As indicated earlier, the antibacterial compounds of this invention are of use in human subjects and the daily dosages to be used will not differ significantly from other, clinically-used, penicillin anti-biotics. The prescribing physician will ultimately determine the appropriate dose for a given human subject, and this can be expected to vary according to the age, weight, and response of the individual patient as well as the nature and severity of the patient's symptoms. The compounds of this invention will normally be used orally at dosages in the range from about 20 to about 100 mg. per kilogram of body weight per day, and parenterally at dosages from about 10 to about 100 mg. per kilogram of body weight per day, usually in divided doses. In some instances it may be necessary to use doses outside these ranges.

The following examples and preparations are provided solely for further illustration. Infrared (IR) spectra were measured as potassium bromide discs (KBr discs) and diagnostic absorption bands are reported in wave numbers (cm^{-1}). Nuclear magnetic resonance spectra (NMR) were measured at 60 MHz for solutions in deuterated chloroform ($CDCl_3$) or deuterated dimethyl sulfoxide (DMSO-d_6), and peak positions are reported in parts per million downfield from tetramethylsilane. The following abbreviations for peak shapes are used: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet.

EXAMPLE 1

1,1-Dioxopenicillanoyloxymethyl 6-[D-(2-amino-2-phenylacetamido)]penicillanate benzenesulfonate dihydrate

To 6.31 g. (0.01 mole) 1,1-dioxopenicillanoyloxymethyl 6-[D-(2-amino-2-phenylacetamido)]penicillanate hydrochloride is added 40 ml. water and the mixture is stirred for about 15 minutes. Insoluble material (ca. 0.75 g. of gum) is removed by filtration and to the filtrate is added a solution of 1.58 g. (0.01 mole) benzenesulfonic acid in 10 ml. water. The resulting gummy mixture is stirred with a glass rod until the salt hardens and breaks up into small lumps. Stirring is continued for one hour (magnetic stirrer) after which the solid is collected by filtration and washed well with water. The washed solid is dried under nitrogen to afford 5.8 g. (77%) of colorless product, M.P. 138°C. (decomp.). ^{1}H-NMR (DMSO-d_6) ppm (delta): 1.38 (s, 6H), 1.45 (s, 6H), 3.0-3.9 (m, 2H), 4.4 (s, 1H), 4.5 (s, 1H), 4.95-5.28 (m, 2H), 5.3-5.66 (m, 2H), 5.89 (s, 2H), 7.15-7.75 (m, 10H); infrared spectrum: (Nujol*) broad band at 1805-1770 cm^{-1}.

X-ray powder diffraction: peaks, degrees 2 theta: 9.3, 11.4, 12.2, 13.4, 15.5, 16.2, 16.9, 17.1, 18.3, 18.9, 19.8, 20.6, 22.3, 22.7, 23.4, 25.4, 26.7, 27.3, 29.6, 30.5, 31.7, 33.5, 34.4, 35.1, 36.1, 37.5, 38.6 and 44.7.

*Trademark for Plough Inc. brand of Mineral Oil.

EXAMPLE 2

1,1-Dioxopenicillanoylmethyl 6-[D-(2-amino-2-phenylacetamido)]penicillanate 4-chlorbenzenesulfonate dihydrate

To a solution of 15 g. (25.25 mmole) 1,1-dioxopenicillanoyloxymethyl 6-[D-(2-amino-2-phenylacetamido)]penicillanate in 150 ml. ethyl acetate is added over ten minutes a solution of 4.85 g. (25.25 mmole) 4-chlorobenzenesulfonic acid in 25 ml. ethyl acetate and 6 ml. water. After the addition is complete, an additional 50 ml. ethyl acetate is added and the resulting mixture is stirred at room temperature overnight. The colorless crystals are collected by filtration, the cake slurried in 200 ml. ethyl ether and filtered again. Upon drying in air 13.7 g. of colorless crystals are obtained.

Ten grams of crystals are dissolved in 100 ml. methanol at room temperature. Water is added to the cloud point (ca. 200 ml.). The resulting hazy solution is stirred at room temperature for two hours during which time the product crystallizes. Upon filtration and air drying overnight, 7.5 g. of product is obtained. ^{1}H-NMR (DMSO-d_6) ppm (delta): 1.36 (s, 6H7, 1.47 (s, 6H), 3.34 (broad, 5H), 3.74 (dd, 1H, J=4 Hz, 17 Hz), 4.40 (s, 1H), 4.51 (s, 1H), 5.08 (m, 2H), 5.48 [m, 2H, (J_{ABq} = 4 Hz upon D_2O overlay)], 5.86 (s, 2H), 7.45 (M, 9H).

Analysis Calculated for $C_{31}H_{35}O_{12}N_4S_3Cl \cdot 2H_2O$:
C 45.22 H 4.77 N 6.81 S 11.68 Cl 4.31
Found: C 45.04 H 4.83 N 6.86 S 11.74 Cl 4.27

Water (Karl Fischer) 4.98 (Theory, 4.37).

X-ray powder diffraction: peaks, degrees 2 theta: 8.9, 10.8, 11.3, 13.2, 15.5, 16.0, 17.1, 18.0, 19.3, 20.0, 22.4, 22.7, 23.3, 26.0, 27.9, 30.0, 30.5, 34.1, 34.5, 35.9, 37.5, 38.5 and 44.8.

EXAMPLE 3

A solution of 64.1 g. (0.108 mole) 1,1-dioxopenicillanoyloxymethyl 6-[D-(2-amino-2-phenylacetamido)]penicillanate in 1400 ml. ethyl acetate (apparent pH 7.6) is adjusted to pH 2.5 by addition of 325 ml. of a solution of 18.0 g. benzenesulfonic acid (90% technical grade) in 400 ml. ethyl acetate. The resulting pale yellow slurry is cooled to 5°C. and granulated for 60 minutes at this temperature. The resulting slurry is washed with an equal volume of water, the layers separated and the ethyl acetate layer is cooled to 5°C. The resulting thick white slurry is filtered, the cake washed with hexane (4 × 100 ml.) and dried in vacuo at 35°C. overnight to afford 42 g. of crystalline benzenesulfonate salt which assayed 4.67% water (Karl Fischer method); % volatiles (60°C., 3 hours in vacuo), 5.00%.

Analysis, Calculated for $C_{31}H_{36}O_{12}N_4S_3 \cdot 2H_2O$:
C 47.20 H 5.11 N 7.10 S 12.19
Found: C 47.14 H 5.21 N 7.12 S 11.92

EXAMPLE 4

Oral Suspension

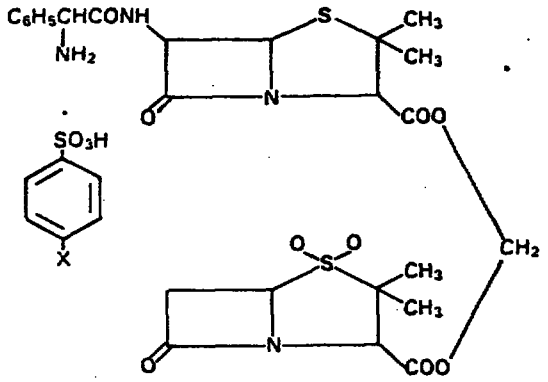
A dry blend of the following ingredients is prepared:

	Grams
Sultamicillin benzenesulfonate dihydrate, crystalline	6.80
Sucrose	20.00
Mannitol	10.00
Sodium citrate	0.40
Hydrated aluminum magnesium silicate powder (Veegum S)	5.00
Kaolin	2.00
Sodium saccharin	2.00
Artificial flavor, powder	0.10

The dry blend is stored in sealed containers until needed, at which time it is diluted to 100 ml. volume with water. The suspension contains the equivalent of 50 mg./ml. of sultamicillin.

Claims for the Contracting States:
BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

1. A benzenesulfonic acid addition salt of sultamicillin of the formula



and hydrated forms thereof, wherein X is hydrogen or chloro.

2. A crystalline dihydrate salt according to claim 1.

3. The crystalline dihydrate salt according to claim 2 wherein X is hydrogen, having the following X-ray powder diffraction peaks:

Peak, degrees 2 theta

9.3	19.8	30.5
11.4	20.6	31.7
12.2	22.3	33.5
13.4	22.7	34.4
15.5	23.4	35.1
16.2	25.4	36.1
16.9	26.7	37.5
17.1	27.3	38.6
18.3	29.6	44.7
18.9		

4. The crystalline salt according to claim 2 wherein X is chloro, having the following X-ray powder diffraction peaks:

Peak, degrees 2 theta

8.9	19.3	30.5
10.8	20.0	34.1
11.3	22.4	34.5
13.2	22.7	35.9
15.5	23.3	37.5
16.0	26.0	38.5
17.1	27.9	44.8
18.0	30.0	

5. A pharmaceutical composition suitable for treating a bacterial infection in a mammalian subject, which comprises an antibacterially effective amount of a compound according to claim 2 and a pharmaceutically acceptable carrier.

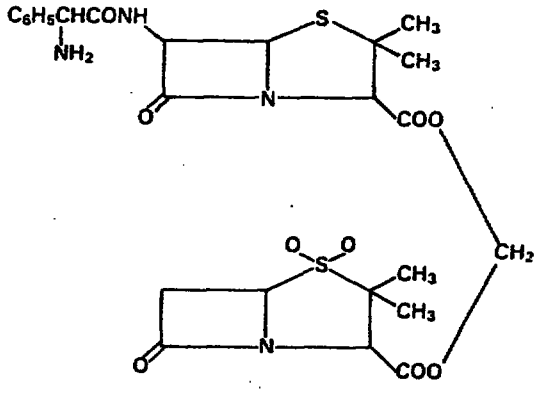
6. A pharmaceutical composition according to claim 5 suitable for pediatric use.

Claims for the Contracting State: AT

1. A process for preparation of a benzenesulfonic acid addition salt of sultamicillin of the formula

$$4\text{-}XC_6H_4SO_3H \cdot B \cdot n(H_2O)$$

where n is 0-2
X is hydrogen or chloro and
B is



characterized in that:

(a) the free base of formula B or an acid addition salt thereof is contacted with a benzenesulfonic acid of formula $4\text{-}XC_6H_4SO_3H$ in the presence of a suitable solvent; or

(b) an acid addition salt of formula B·HY where Y is Cl, Br or I, is contacted with a benzenesulfonic acid salt of the formula $4\text{-}XC_6H_4SO_3M$, where M is an alkali metal or alkaline earth cation, in the presence of water.

2. A process according to claim 1 when carried out at room temperature or below.

3. A process according to claim 1 wherein n is 2.

4. A process according to claim 1, part (b), wherein Y is Cl and M is Na.

5. A process according to claim 3 wherein X ist hydrogen and a crystalline dihydrate benzenesulfonic acid addition salt in obtained.

6. A process according to claim 3 wherein X is chloro and a crystalline dihydrate benzenesulfonic acid salt is obtained.

Patentansprüche für die Vertragsstaaten:
BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

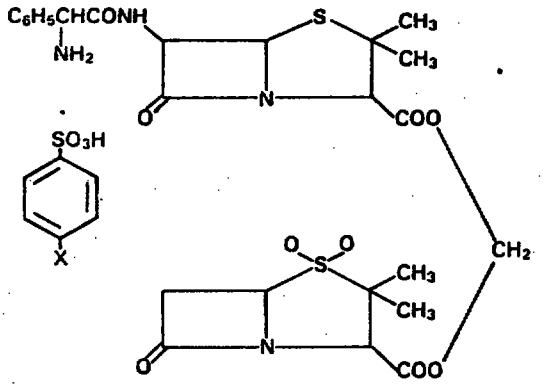
1. Benzolsulfonsäure-Additionssalz von Sultamicillin mit der Formel

	Grams
Sultamicillin benzenesulfonate dihydrate, crystalline	6.80
Sucrose	20.00
Mannitol	10.00
Sodium citrate	0.40
Hydrated aluminum magnesium silicate powder (Veegum S)	5.00
Kaolin	2.00
Sodium saccharin	2.00
Artificial flavor, powder	0.10

The dry blend is stored in sealed containers until needed, at which time it is diluted to 100 ml. volume with water. The suspension contains the equivalent of 50 mg./ml. of sultamicillin.

Claims for the Contracting States:
BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

1. A benzenesulfonic acid addition salt of sultamicillin of the formula



and hydrated forms thereof, wherein X is hydrogen or chloro.

2. A crystalline dihydrate salt according to claim 1.

3. The crystalline dihydrate salt according to claim 2 wherein X is hydrogen, having the following X-ray powder diffraction peaks:

Peak, degrees 2 theta

9.3	19.8	30.5
11.4	20.6	31.7
12.2	22.3	33.5
13.4	22.7	34.4
15.5	23.4	35.1
16.2	25.4	36.1
16.9	26.7	37.5
17.1	27.3	38.6
18.3	29.6	44.7
18.9		

4. The crystalline salt according to claim 2 wherein X is chloro, having the following X-ray powder diffraction peaks:

Peak, degrees 2 theta

8.9	19.3	30.5
10.8	20.0	34.1
11.3	22.4	34.5
13.2	22.7	35.9
15.5	23.3	37.5
16.0	26.0	38.5
17.1	27.9	44.8
18.0	30.0	

5. A pharmaceutical composition suitable for treating a bacterial infection in a mammalian subject, which comprises an antibacterially effective amount of a compound according to claim 2 and a pharmaceutically acceptable carrier.

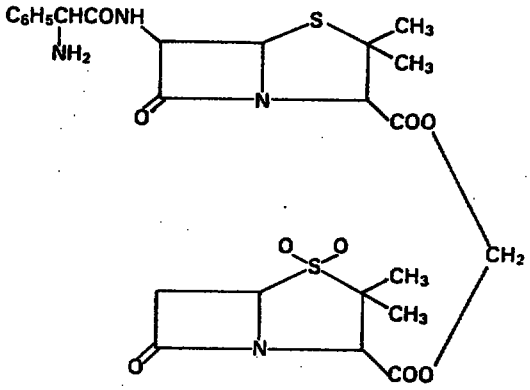
6. A pharmaceutical composition according to claim 5 suitable for pediatric use.

Claims for the Contracting State: AT

1. A process for preparation of a benzenesulfonic acid addition salt of sultamicillin of the formula

$$4\text{-}XC_6H_4SO_3H \cdot B \cdot n(H_2O)$$

where n is 0-2
X is hydrogen or chloro and
B is



characterized in that:

(a) the free base of formula B or an acid addition salt thereof is contacted with a benzenesulfonic acid of formula $4\text{-}XC_6H_4SO_3H$ in the presence of a suitable solvent; or

(b) an acid addition salt of formula B·HY where Y is Cl, Br or I, is contacted with a benzenesulfonic acid salt of the formula $4\text{-}XC_6H_4SO_3M$, where M is an alkali metal or alkaline earth cation, in the presence of water.

2. A process according to claim 1 when carried out at room temperature or below.

3. A process according to claim 1 wherein n is 2.

4. A process according to claim 1, part (b), wherein Y is Cl and M is Na.

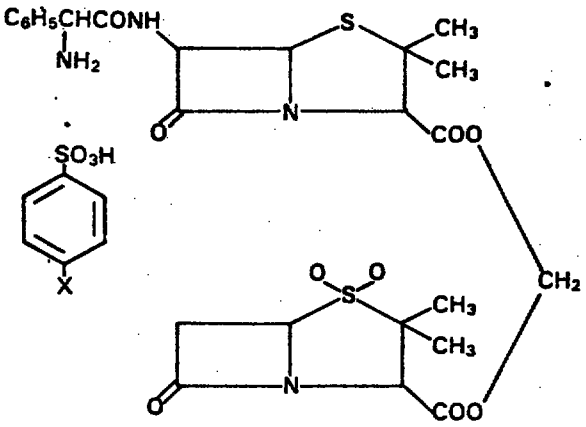
5. A process according to claim 3 wherein X ist hydrogen and a crystalline dihydrate benzenesulfonic acid addition salt in obtained.

6. A process according to claim 3 wherein X is chloro and a crystalline dihydrate benzenesulfonic acid salt is obtained.

Patentansprüche für die Vertragsstaaten:
BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

1. Benzolsulfonsäure-Additionssalz von Sultamicillin mit der Formel

* C L M S *



und dessen hydratisierte Formen, worin X Wasserstoff oder Chlor ist.

2. Kristallines Dihydrat-Salz nach Anspruch 1.

3. Kristallines Dihydrat-Salz nach Anspruch 2, worin X Wasserstoff ist und welches die folgenden Röntgen-Pulver-Beugungs-Peaks aufweist:

Peak, Winkelgrade 2 Θ

9.3	19.8	30.5
11.4	20.6	31.7
12.2	22.3	33.5
13.4	22.7	34.4
15.5	23.4	35.1
16.2	25.4	36.1
16.9	26.7	37.5
17.1	27.3	38.6
18.3	29.6	44.7
18.9		

4. Kristallines Salz nach Anspruch 2, worin X Chlor ist und welches die folgenden Röntgen-Pulver-Beugungs-Peaks aufweist:

Peak, Winkelgrade 2 Θ

8.9	19.3	30.5
10.8	20.0	34.1
11.3	22.4	34.5
13.2	22.7	35.9
15.5	23.3	37.5
16.0	26.0	38.5
17.1	27.9	44.8
18.0	30.0	

5. Pharmazeutische Zusammensetzung, geeignet zur Behandlung einer bakteriellen Infektion in einem Säuger, die eine antibakteriell wirksame Menge einer Verbindung nach Anspruch 2 und einen pharmazeutisch annehmbaren Träger enthält.

6. Pharmazeutische Zusammensetzung nach Anspruch 5, die für pädiatrische Zwecke geeignet ist.

Patentansprüche für den Vertragsstaat: AT

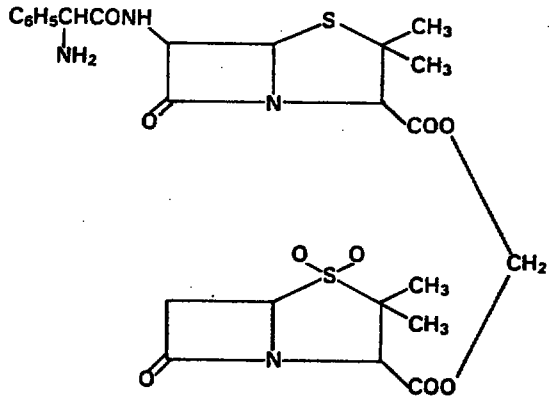
1. Verfahren zur Herstellung eines Benzolsulfonsäure-Additionssalzes von Sultamicillin der Formel

$$4\text{-}XC_6H_4SO_3H \cdot B \cdot n(H_2O)$$

worin n 0 - 2,

X Wasserstoff oder Chlor und

B



ist, gekennzeichnet dadurch, dass

(a) die freie Base der Formel B oder deren Säureadditionssalz mit einer Benzolsulfonsäure der Formel $4\text{-}XC_6H_4SO_3H$ in Gegenwart eines geeigneten Lösungsmittels zusammengebracht oder

(b) das Säureadditionssalz der Formel B·HY, worin Y Cl, Br oder J ist, mit einem Benzolsulfonsäuresalz der Formel $4\text{-}XC_6H_4SO_3M$, worin M ein Alkalimetall- oder Erdalkalimetallkation ist, in Gegenwart von Wasser zusammengebracht wird.

2. Verfahren nach Anspruch 1, wenn es bei Raumtemperatur oder darunter durchgeführt wird.

3. Verfahren nach Anspruch 1, worin n gleich 2 ist.

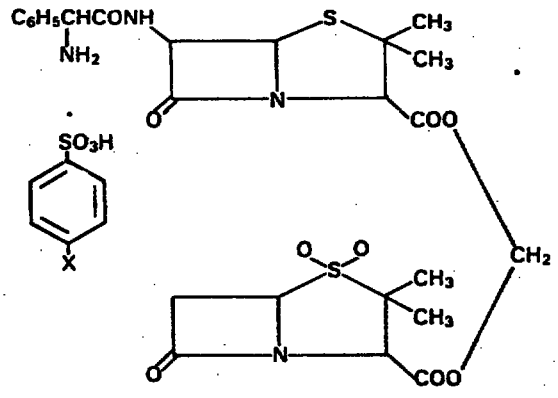
4. Verfahren nach Anspruch 1, Teil (b), worin Y gleich Cl und M gleich Na ist.

5. Verfahren nach Anspruch 3, worin X Wasserstoff ist und man ein kristallines Dihydrat-Benzolsulfonsäure-Additionssalz erhält.

6. Verfahren nach Anspruch 3, worin X Chlor ist und man ein kristallines Dihydrat-Benzolsulfonsäure-Salz erhält.

Revendications pour les Etats contractants: BE, CH, DE, FR, GB, IT, LI, LU, NL, SE

1. Sel d'addition d'acide benzènesulfonique de la sultamicilline de formule



et ses formes hydratées, formule dans laquelle X est l'hydrogène ou le radical chloro.

2. Sel dihydraté cristallin suivant la revendication 1.

* C L M S *

3. Sel dihydraté cristallin suivant la revendication 2, dans lequel X est l'hydrogène, présentant les pics de diffraction des rayons X sur poudre suivants:

Pic, degrés 2 thêta

9,3	19,8	30,5
11,4	20,6	31,7
12,2	22,3	33,5
13,4	22,7	34,4
15,5	23,4	35,1
16,2	25,4	36,1
16,9	26,7	37,5
17,1	27,3	38,6
18,3	29,6	44,7
18,9		

4. Sel dihydraté cristallin suivant la revendication 2, dans lequel X est le radical chloro, présentant les pics de diffraction des rayons X sur poudre suivants:

Pic, degrés 2 thêta

8,9	19,3	30,5
10,8	20,0	34,1
11,3	22,4	34,5
13,2	22,7	35,9
15,5	23,3	37,5
16,0	26,0	38,5
17,1	27,9	44,8
18,0	30,0	

5. Composition pharmaceutique apte à être utilisée pour le traitement d'une infection bactérienne chez un mammifère, qui comprend une quantité à effet antibactérien d'un composé suivant la revendication 2 et un support pharmaceutiquement acceptable.

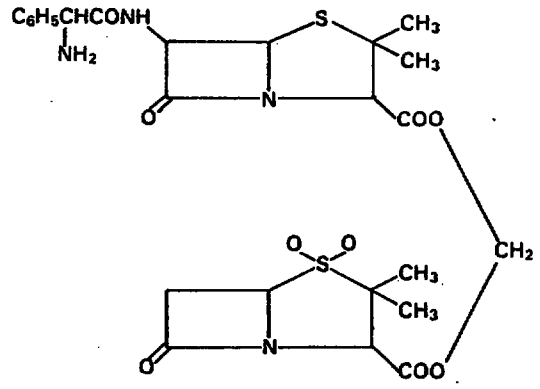
6. Composition pharmaceutique suivant la revendication 5, à usage pédiatrique.

Revendications pour l'Etat contractant: AT

1. Procédé de préparation d'un sel d'addition d'acide benzènesulfonique de la sultamicilline de formule

$4\text{-}XC_6H_4SO_3H \cdot B \cdot n(H_2O)$

dans laquelle n a une valeur de 0-2
X est l'hydrogène ou le radical chloro et
B représente



caractérisé en ce que:

(a) la base libre de formule B ou un sel d'addition d'acide de cette base est mis en contact avec un acide benzènesulfonique de formule $4\text{-}XH_6H_4SO_3H$ en présence d'un solvant convenable; ou bien

(b) un sel d'addition d'acide de formule B·HY dans laquelle Y représente Cl, Br ou I, est mis en contact avec un sel d'acide benzènesulfonique de formule $4\text{-}XC_6H_4SO_3M$, dans laquelle M est un cation de métal alcalin ou alcalinoterreux, en présence d'eau.

2. Procédé suivant la revendication 1, mis en œuvre à la température ambiante ou au-dessous de cette température.

3. Procédé suivant la revendication 1, dans lequel n a la valeur 2.

4. Procédé suivant la revendication 1, partie (b) dans lequel Y représente Cl et M représente Na.

5. Procédé suivant la revendication 3, dans lequel X est l'hydrogène, et on obtient un sel d'addition d'acide benzènesulfonique dihydraté cristallin.

6. Procédé suivant la revendication 3, dans lequel X est le radical chloro et on obtient un sel d'acide benzènesulfonique dihydraté cristallin.

* C L M S *