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Titre : Dronedarone for use in leishmaniasis, formulations and associations for use in leishmaniasis.

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Abrégé :

The invention relates to dronedarone or one of its pharmaceutically acceptable salts for the treatment of leishmaniasis, formulations and associations comprising dronedarone or one of its pharmaceutically acceptable salts for the treatment of leishmaniasis.

DRONEDARONE FOR USE IN LEISHMANIASIS, FORMULATIONS AND ASSOCIATIONS FOR USE IN LEISHMANIASIS.

5 The present invention relates to dronedarone or one of its pharmaceutically acceptable salts for the treatment of leishmaniasis, in particular cutaneous leishmaniasis with its various strains around the world, and/or leishmaniasis issued from *Leishmania amazonensis*, *Leishmania donovani*, or *Leishmania major* as well to formulation in particular topical formulation comprising dronedarone or one of its pharmaceutically acceptable salts, to their preparation and to their therapeutic application.

2-n-Butyl-3-[4-(3-di-n-butylaminopropoxy)benzoyl]-5-methylsulphonamidobenzofuran, or dronedarone, and pharmaceutically acceptable salts thereof, in particular its hydrochloride salts, are described in European Patent EP 0 471 609 B1.

15 Moreover, dronedarone is indicated to reduce the risk of hospitalization for atrial fibrillation in patients in sinus rhythm with a history of paroxysmal or persistent atrial fibrillation (AF) or is indicated for the maintenance of sinus rhythm after successful cardioversion in adult clinically stable patients with paroxysmal or persistent atrial fibrillation (AF).

20 Surprisingly, the applicant has now showed that dronedarone may be used to treat leishmaniasis.

Especially, the applicant proposed formulations for topical administration that are suitable to treat leishmaniasis.

In fact, to be effective, such formulation should allow the penetration/liberation of the active principle in the layer of the skin where the parasites are located.

It would then be possible to obtain high concentrations of the active drug locally in the dermis, and avoiding high plasma concentration of the drug and associated systemic side effects.

One additional feature of such formulation is to avoid/reduce toxicity reactions of the skin on contact with the formulation.

35 Furthermore, association of dronedarone with others anti-leishmaniasis agents is possible and has several advantages such as decreasing the dose of administrated

drugs to avoid side effects and avoid apparition of resistances to the chosen treatment with time.

Thus, the present invention relates to formulation in particular topical formulation comprising dronedarone or one of its pharmaceutically acceptable salts and at least a pharmaceutically acceptable excipient, to their preparation and to their therapeutic application such as treatment of leishmaniasis, in particular cutaneous leishmaniasis and/or leishmaniasis issued from *Leishmania amazonensis*, *Leishmania donovani* or *Leishmania major* strains.

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The present invention relates to a pharmaceutical composition in particular for topical administration (topical pharmaceutical composition) comprising dronedarone or one of its pharmaceutically acceptable salts and at least a pharmaceutically acceptable excipient for topical administration, to their preparation and to their therapeutic application such as treatment of leishmaniasis, in particular cutaneous leishmaniasis and/or leishmaniasis issued from *Leishmania amazonensis*, *Leishmania donovani* or *Leishmania major* strains.

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The present invention also relates to the use of dronedarone or one of its pharmaceutically acceptable salts for the preparation of a medicine for the treatment of leishmaniasis particularly cutaneous leishmaniasis and/or leishmaniasis issued from *Leishmania amazonensis*, *Leishmania donovani* or *Leishmania major* strains.

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The present invention also relates to dronedarone or one of its pharmaceutically acceptable salts for use in the treatment of leishmaniasis particularly cutaneous leishmaniasis and/or leishmaniasis issued from *Leishmania amazonensis*, *Leishmania donovani* or *Leishmania major* strains.

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Another objet of the invention is also an association or one of its pharmaceutically acceptable salts and an anti-leishmaniasis agent. Said association is used for the treatment of leishmaniasis particularly cutaneous leishmaniasis and/or leishmaniasis issued from *Leishmania amazonensis*, *Leishmania donovani* or *Leishmania major* strains.

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In one embodiment, said anti-leishmaniasis agent is selected among the following agents:

- Miltefosine or one of its pharmaceutically acceptable derivatives,

- Amphotericin B or one of its pharmaceutically acceptable derivatives,
- pentavalent antimonials derivatives such as meglumine antimoniate.

Said pharmaceutically acceptable salt of dronedarone is the hydrochloride salt.

5

In one embodiment, said leishmaniasis is issued from *Leishmania* strains resistant to pentavalent antimonials derivatives, and in particular *Leishmania amazonensis* strains, resistant to pentavalent antimonials derivatives in particular resistant to meglumine antimoniate.

10

It may be mentioned that formulations of meglumine antimoniate are notably commercialized under the trademark Glucantime®.

15

Said topical formulation or pharmaceutical composition may be a hydro-alcoholic gel, a semi-solid hydrophilic waxy formula, an oil in water or a water in oil emulsion particularly a hydro-alcoholic gel.

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Said topical formulation or pharmaceutical composition may comprise an excipient such as hydroxypropyl methylcellulose (HPMC) in particular HPMC at 2% of the total weight of the formulation.

25

In one embodiment, said topical formulation or pharmaceutical composition may be a hydro-alcoholic gel comprising at least hydroxypropyl methylcellulose as excipient.

Said topical formulation or pharmaceutical composition wherein dronedarone or one of its pharmaceutically acceptable salt may be used in a proportion of 10% by weight of the active principle in base form.

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Higher or lower dosages may be appropriate; these dosages are comprised within the scope of the present invention.

It may be mentioned that the term formulation or composition may be used indifferently.

35

The examples which follow describe the preparation of certain formulations in accordance with the invention. These examples are not limitative, and merely illustrate the present invention.

**EXAMPLE 1**

Tests against cutaneous leishmaniasis were performed using the experimental model of BALB/c mouse infection with *Leishmania amazonensis*.

5

**Formulations:**

Formulations are prepared using techniques well known by one skilled in the art.

10      **a) Dronedarone.**

<b>Formulation 5</b>	<b>Dronedarone</b>	aqueous gel, [Dronedarone] =10% , in 20g vial
<b>Formulation 6</b>	<b>Dronedarone</b>	semi solid hydrophilic waxy formula, [Dronedarone] = 10% , in 20g vial
<b>Formulation 7</b>	<b>Dronedarone</b>	oil in water emulsion, [Dronedarone] = 10% , in 20g vial

Formulations 5, 6 and 7 are detailed below:

<b>Formulation 5 (hydro-alcoholic gel = aqueous gel)</b>	<b>%</b>
citrate buffer 0.5M pH 4.0	44
Ethanol	44
HPMC	2
dronedarone	10 (eq.base)

<b>Formulation 6 (semi-solid hydrophilic waxy)</b>	<b>%</b>
Lauroyl polyoxylglycerides (Gelucire 44/14)	75
Propylene glycol	15
dronedarone	10 (eq.base)

15

<b>Formulation 7 (oil in water emulsion*)</b>	<b>%</b>
Anionic self-emulsifying base based on palmitostearate derivatives (SEDEFOS 75)	8.1
Soya oil	22.5
Glycerin	59.4
dronedarone	10 (eq. Base)

\* Water is replaced by an hydrophilic excipient. Thus, the emulsion is constituted by droplets of oil dispersed in a hydrophilic matrix.

**b) Control Glucantime formulations :**

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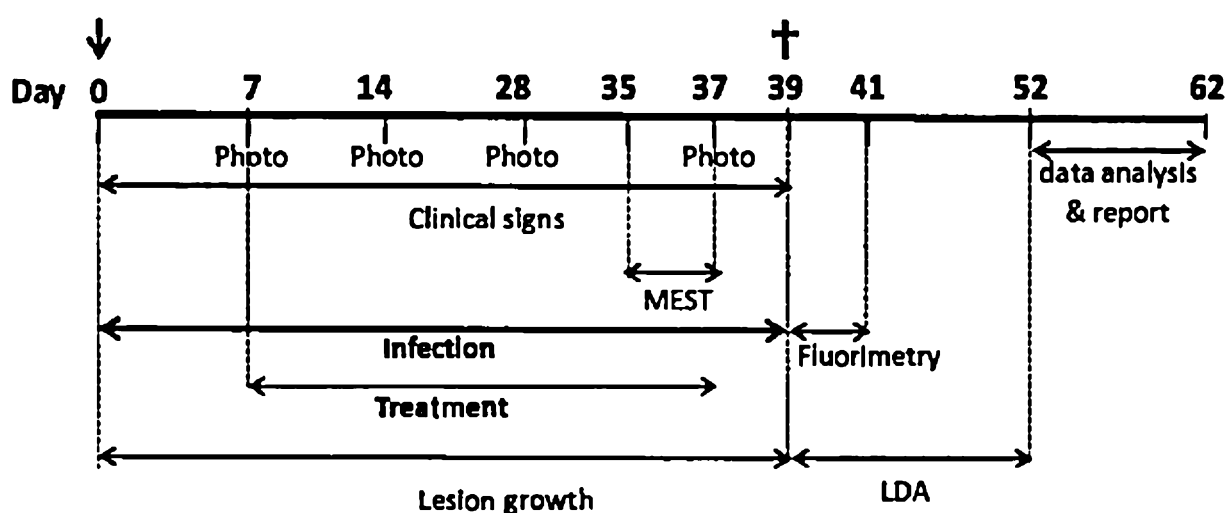
- Glucantime- PBS formulation #8 : injectable formulation of Glucantime mixed with sterile PBS (20 mg / ml), stored at 4°C.

This preparation is equivalent to the commercial Glucantime®, identified by WHO as a first intention treatment for cutaneous leishmaniasis.

5

## Procedures

### 10 a) Protocol timelines:



### b) Infection

- 15 Mice at 8 weeks of age were infected with 10 µl of 10<sup>6</sup> promastigotes in the right ear pinna under light ether anesthesia.

### c) Lesion growth

- 20 Infected and non-infected contralateral ear thicknesses were measured every 3-4 days with a caliper gauge, and the lesion sizes were expressed as the difference between the thickness of infected and non-infected ears.

### d) Treatment with intra lesional glucantime and topical dronedarone

On day 7 of infection, animals were randomly separated at 5 animals / mouse cage (1 group of animals for each dronedarone or glucantime formulation). Another infected group was only for infection follow-up.

5           I) Topical treatment: Infected ears were treated with approx 20 mg of the appropriate topical dronedarone formulation once a day for 30 days. The formulations were collected from their original recipient with the tip of a disposable plastic spatula, and spread in the inner side of the infected pinna under a 10 secs-massage using the same spatula:

10           II) Intralesional treatment: Infected ears were s.c. injected in the inner side of the infected ear with 10 µl of PBS containing 200 µg of powder Glucantime, twice a week from days 7 to 37 of infection (8 doses):

e) Cutaneous sensitization (MEST):

15   Mouse Ear Swelling Test (MEST) can detect reliably moderate to strong sensitizers, as indicated by OECD guidelines for testing of chemicals. On day 34 of infection the contralateral non-infected ears were treated (challenged) with the correspondent Dronedarone formulation. Ear swelling was measured at various times after challenge (0h, 1h, 5h, 24h, 48 h and 72 h).

20

f) Clinical signs:

Animals were weighted on days 0 of infection and at weekly periods, subsequently. The animals were observed daily, for signs of morbidity and death. Abnormal clinical signs during these routine checks were recorded. Clinical observations including mortality, monitoring of convulsions, lethargy, sleep, coma, salivation, diarrhea, cage side examination, skin color, fur, eyes and mucous membrane, spontaneous and voluntary motor activity and necropsy – in case the animal dies were recorded. Any unusual aspect of the treated lesions such as vesicles, complete ulceration, crust, darkening were also recorded. according to the international guidelines (WHO /OECD).

30

g) Pictures

Pictures from infected ears (treated and untreated) were taken with a digital camera at weekly intervals.

35

#### h) Parasite load by Limiting Dilution Assay (LDA)

On day 39 of infection, animals were sacrificed under anesthesia and the infected ears were aseptically cleaned with iodinated ethanol followed by ethanol alone. The ears were cut off along its base and aseptically weighted. They were then individually cut into pieces, and single-cell suspensions were prepared in PBS containing antibiotics (1 ml / ear) using a stainless steel mesh (Sigma). The sieved tissues were gently pipetted up-down 8 x for cell dissociation. The cell suspensions were pre-diluted 500x in medium M199 supplemented with 10% heat inactivated foetal calf serum, antibiotics 100 U/ml Penicilin / 100 µg/ml streptomycin, 5 ug/ml hemine and 2% human urine), and then serially diluted 3-fold (50 µl + 100µl) in triplicates in flat-bottom micropates for a total of 24 dilutions. Microplates were incubated at 26°C in a humidified BOD Incubator. Wells were checked every 3-4 days for the presence of promastigotes for up to 20 days. The number of parasites in each infected ear was calculated according to the tissue mass and the last dilution theoretically containing 1 tissue amastigote.

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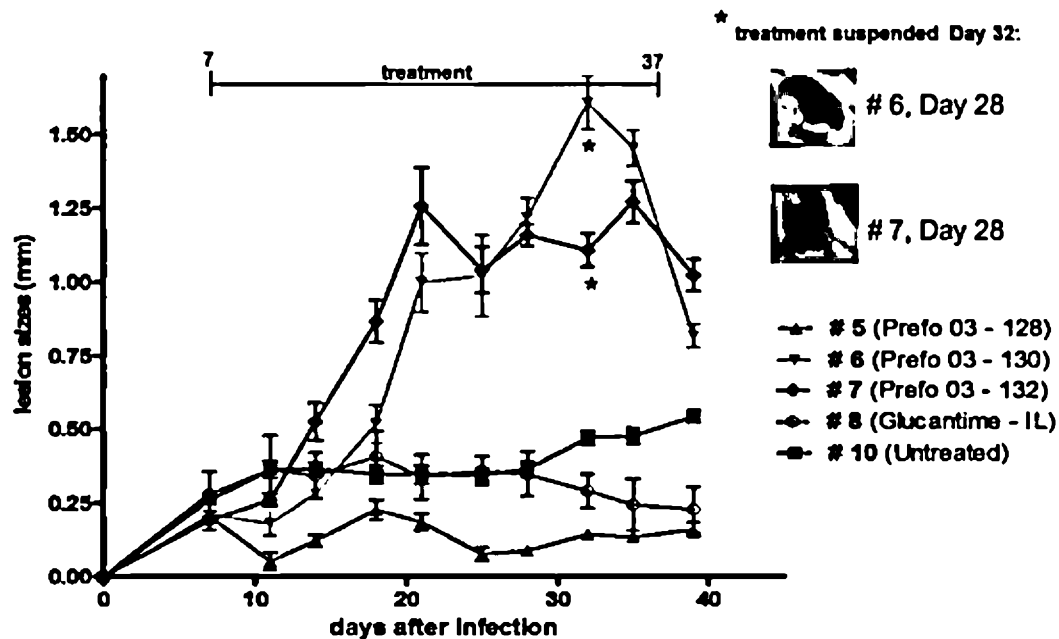
#### Results on efficacy of dronedarone formulations:

**Dronedarone: Lesion growth:** Formulation # 5 (aqueous gel) was very effective throughout treatment, close to the reference treatment # 8 (intralesional Glucantime) (Fig 9). Formulations # 6 (hydrophilic waxy semi-solid) and # 7 (emulsion o/w) induced increased lesion sizes. This was due to skin irritancy (see MEST Fig 11), not to promoted parasite growth (see Fig 10). Besides, suspension of # 6 and # 7 treatments on day 32 led to rapid decrease of ear thicknesses: afterwards:

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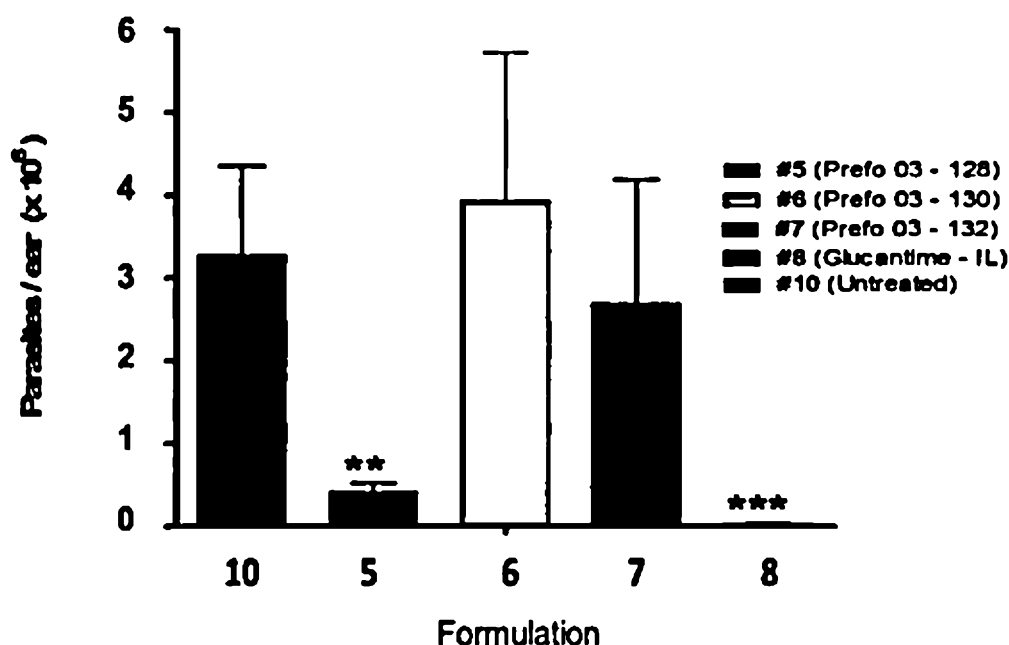


## LESION GROWTH - Dronedarone formulations



**Figure 9: Lesion growth in Dronedarone-treated mice.** Mice were infected on Day 0. Topical daily treatment started on Day 7 and continued until Day 37 with all the indicated Dronedarone formulations, except for Groups # 6 and #7 which treatment was suspended on Day 32 due to toxicity (skin irritancy). The lesion sizes were measured at the indicated times (n=5).

**Dronedarone: Parasite loads in the ear.** On day 39 of infection (30 days of treatment), the parasite loads in the ears were significantly lower in the group topically treated with # 5 (aqueous gel). Formulations # 6 (hydrophilic waxy semi-solid) and # 7 (emulsion o/w) did not alter the parasite loads (Fig 10):



**Figure 10: Parasite loads in Dronedarone-treated mice.** On day 39 of infection, the parasite loads in the ears of mice treated with the indicated formulations as for Fig 9 were determined by Limiting Dilution Assay. Means  $\pm$  SD (n=5). \*\*  $p < 0.005$ , \*\*\*  $p < 0.001$

### Conclusions

The formulation 5 was the most promising in the control of lesion growth throughout the infection, the low parasite load at the end of the experiment was compatible with the controlled lesion growth, similar to achieved with 8 doses of 200  $\mu$ g intralesional Glucantime. The animals looked happy throughout the treatment, gained weight normally and did not mount cutaneous sensitivity upon challenge.

### EXAMPLE 2

In vitro study of the efficacy of dronedarone on a strain of *Leishmania amazonensis*, in comparison with the reference treatments meglumine antimoniate, miltefosine, and amphotericin B in similar laboratory conditions..

A strain of *Leishmania amazonensis* (MHOM / BR / 73 / M2269) were used. Dronedarone hydrochloride and meglumine antimoniate were supplied by Sanofi. Amphotericin B (désoxycholate) and miltefosine were bought at Sigma-Aldrich.

The study concerned two cellular models:

- 1/ Axenic amastigotes of *L. amazonensis* (isolated parasites)
- 2/ Intramacrophagic amastigotes of *L. amazonensis* (parasites hosted in macrophages, as found in dermis, during the cutaneous Leishmaniosis infection).

The first cellular model which cultivates in a medium based on M199, allows defining the intrinsic activity of a substance on the parasite itself while the second cellular model integrates the capacity of the substance to cross the membrane of the macrophage and that of the phagolysosome. The used macrophages are cells RAW 264.7, which cultivate in medium based on DMEM with 10 % of foetal serum of veal.

- Determination of the IC50 of each of the molecules

Solutions of dronedarone in the DMSO, meglumine antimoniate and miltefosine in the water, and amphotericin B in an isotonic glucose solution (G5) were prepared before every experiment. The evaluations in vitro were the object of three independent experiments duplicate. The assays were realized by quantifying the parasitic DNA with the SYBRGREEN as described by Audisio and al. (Eur. J. Med. Chem., 52: 44-50, 2012) as well as by qPCR for intramacrophagic amastigotes with amplification of the alpha-tubuline of the parasite. The results obtained with both methods are similar.

The inhibition concentration of 50 % of the growth of the parasites (IC50) was determined after 72 hours of contact with dronedarone compared with meglumine antimoniate, miltefosine and amphotericin B, used as reference products.

On axenic amastigotes (test conditions 1/), dronedarone has a IC50 of  $0,34 \pm 0,06 \mu\text{M}$ , while meglumine antimoniate has a IC50 of  $908 \pm 159 \mu\text{M}$ , miltefosine a IC50 of  $0,9 \pm 0,2 \mu\text{M}$  and amphotericin B a IC50 of  $0,031 \pm 0,002 \mu\text{M}$ .

On intramacrophagic amastigotes (test conditions 2/), dronedarone has a IC50 of  $0,50 \pm 0,22 \mu\text{M}$ , while meglumine antimoniate has a IC50 of  $133,63 \pm 10,41 \mu\text{M}$ , miltefosine a IC50 of  $1,87 \pm 0,032 \mu\text{M}$  and amphotericin B a IC50 of  $0,047 \pm 0,005 \mu\text{M}$ .

- Evaluation of the potential toxicity of dronedarone on human host cells (macrophages) compared to the reference drugs.

Study of the cytotoxicity on macrophages (cells RAW 264.7)

The non-toxic maximal concentration (CMA) was determined by the technique to the Blue Trypan according to the method described in Audisio and al. (Eur. J. Med. Chem., 52: 44-50, 2012).

The CMA of the dronedarone is 12,5  $\mu$ M

The CMA of the meglumine antimoniate is > 200  $\mu$ M.

The CMA of the amphotericin B is 6,25  $\mu$ M

The CMA of the miltefosine is 50  $\mu$ M

- 5 Then, the toxicity of dronedarone on the dermis macrophages is lower than most of the reference drugs, and will not impede its therapeutic use for cutaneous leishmaniasis.

- 10 • Study of the association of dronedarone with meglumine antimoniate, miltefosine and amphotericin B

Association of dronedarone with each of the reference products was studied according to the method described by Odds and al., J. Antimicrob. Chemother., 52:1, 2003, to identify a synergic or additive or antagonistic action. The study comprised three independent experiments which allowed the calculation of the Fractional Inhibitory Concentration Index (FICI):

- 15 - If FICI < 0,5: Synergy  
- If 0,5 < FICI < 4: additive Effect, no interaction  
- If FICI > 4: antagonism

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- Interaction between dronedarone and meglumine antimoniate:

On axenic amastigotes , FICI = 0,27. A synergic effect between dronedarone and meglumine antimoniate was obtained.

On intramacrophagic amastigotes, FICI = 0,79. An additive effect between dronedarone and meglumine antimoniate was obtained.

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- Interaction between the dronedarone and the miltefosine:

On axenic amastigotes , FICI = 0,39. A synergy between dronedarone and miltefosine was obtained.

30 On intramacrophagic amastigotes , FICI = 0,46. A synergy between dronedarone and miltefosine was obtained.

- Interaction between dronedarone and amphotericin B:

On axenic amastigotes, FICI = 0,63. An additive effect between dronedarone and amphotericin B was obtained.

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On intramacrophagic amastigotes, FICI = 0,54. An additive effect between dronedarone and amphotericin B was obtained.

### Conclusions

5

**A / activity of dronedarone on the parasites, as compared with reference drugs.:**

Dronedarone presents a strong activity anti-leishmaniasis in vitro on both models axenic amastigotes and intramacrophagic amastigotes of *Leishmania amazonensis*, with lower IC50 within the micromolar range, what places it between amphotericin B and miltefosine, in term of activity. The intrinsic activity on the parasite itself is thus maintained when this one is protected in the phagolysosome inside the macrophage.

10

**B/ activity of dronedarone on the parasites, in association with reference drugs:**

The interaction of dronedarone with meglumine antimoniate or with amphotericin B is additive type. No antagonistic effect was demonstrated, what suggests that a concomitant use of dronedarone with meglumine antimoniate or amphotericin B may be possible.

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The interaction of dronedarone with miltefosine is of synergic type suggests that a concomitant use of dronedarone with miltefosine may be of interest for example to decrease the administrated doses.

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### EXAMPLE 3

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#### In vitro study on *Leishmania amazonensis* strains resistant to meglumine antimoniate (Glucantime®)

30 On *Leishmania amazonensis* strains resistant to meglumine antimoniate (IC50 = 200mM) under promastigote form, chemosensitivity to dronedarone is similar that one observed on strains that are not resistant to meglumine antimoniate (active principle of Glucantime®).

That means that the mechanism of action of dronedarone on the parasites differs from the one of glucantime. Dronedarone has a potential to treat Glucantime resistant strains as found eg. in Latin America.

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**EXAMPLE 4**

5 **In vitro study on building of resistance to Dronedarone with time, using *Leishmania amazonensis* strain.**

The test consists in long term culture of a *L. amazonensis* strain ( promastigote form), in contact with increasing doses of dronedarone, starting with initial concentrations lower than the IC 50.

- 10 At regular timepoints , the viability and pathogenicity of parasites is confirmed with moving the culture to axenic amastigotes and intramacrophagic amastigotes, and calculating the new inhibitive concentration for 50% of the population (IC50).

- 15 After six months of culture and exposition of the parasites to dronedarone, no significant modification of the inhibitory concentration (IC 50) was observed.

As a reference: a similar exposition of the strain to Glucantime has brought to an increase of the IC 50 x 200.

- 20 While the study will be continued for a while, it can already be stated that the molecule does not generate a resistance in exposed parasites.

**EXAMPLE 5**

25 **In vitro study on *Leishmania donovani* and *Leishmania major***

As to evaluate the polyvalence of dronedarone as a treatment on the various strains of *Leishmania* spread around the world, with known various sensitivities to the reference drugs, the previous tests were completed with strains considered as representative of the various zones of endemy.

- 30 Strains of *Leishmania donovani* (MHOM / ET / 67 / HU3) and *Leishmania major* (MHOM / SU / 73 / 5-ASKH) were used for this study.

Dronedarone hydrochloride and the meglumine antimoniate were supplied by Sanofi. Miltefosine was bought at Sigma-Aldrich.

- 35 The study in vitro concerned four cellular models:

- 1/ Axenic amastigotes of *L. donovani* and *L. major* ( isolated parasites)

- 2/ Intramacrophagic amastigotes of *L. donovani* and *L. major* (parasites hosted in macrophages, as found in dermis, during the cutaneous Leishmaniasis infection).

5 The model of axenic amastigotes is cultivated in a medium based on M199 and allows defining the intrinsic activity of a substance on the parasite itself while the model of intramacrophagic amastigotes integrates the capacity of the substance to cross the membrane of the macrophage and that of the phagolysosome.

10 The used macrophages are cells RAW 264.7, which cultivate in a medium based on DMEM with 10 % of foetal serum of veal.

Determination of the IC50 of dronedarone, Glucantime® and of miltefosine:

15 The solutions of dronedarone in the DMSO, meglumine antimoniate and miltefosine in the water, were prepared before every experiment. The evaluations in vitro were the object of three independent experiments.

The assays were realized by quantifying the parasitic DNA with the SYBRGREEN as described by Audisio and al. (Eur. J. Med. Chem., 52: 44-50, 2012).

20 The inhibition concentration of 50 % of the growth of the parasites (IC50) was determined after 72 hours of contact with dronedarone compared with meglumine antimoniate and miltefosine, used as reference products.

25 - On the axenic amastigotes of *L. donovani*, dronedarone has a IC50 of  $47,38 \pm 6,27 \mu\text{M}$ , while meglumine antimoniate has a IC50  $> 1000 \text{ mM}$ , and miltefosine a IC50 of  $13,0 \pm 1,25 \mu\text{M}$ .

- On *L. major*'s axenic amastigotes, dronedarone has a IC50 of  $2,55 \pm 0,51 \mu\text{M}$ , while meglumine antimoniate has a IC50  $> 1000 \mu\text{M}$ , and miltefosine a IC50 of  $5,57 \pm 1,50 \mu\text{M}$ .

30 - On the intramacrophagic amastigotes of *L. donovani*, dronedarone has a IC50 of  $1,67 \pm 0,10 \mu\text{M}$ , while meglumine antimoniate has a IC50 of  $390,36 \pm 40,46 \mu\text{M}$ , and miltefosine a IC50 of  $0,88 \pm 0,10 \mu\text{M}$ .

35 - On *L. major*'s intramacrophagic amastigotes, dronedarone has a IC50 of  $1,32 \pm 0,12 \mu\text{M}$ , while meglumine antimoniate has a IC50 of  $347,98 \pm 79,87 \mu\text{M}$ , and miltefosine a IC50 of  $0,72 \pm 0,11 \mu\text{M}$ .

Besides, dronedarone does not present toxicity for macrophages to the concentration of 12,5  $\mu$ M. Its cytotoxic concentration 50 % (CC50) is thus superior to 12,5.

### Conclusions

5

1-in vitro activity of the dronedarone on *Leishmania donovani* (as a model of Indian/African strains)

The dronedarone presents a strong activity on intramacrophagic amastigotes of *L. donovani* similar to that of miltefosine, of the order of 1-2  $\mu$ M, while it is weakly active on axenic amastigotes. The therapeutic index of dronedarone defined as the CC50 on intramacrophagic amastigotes of *L. donovani* / IC50 is thus superior to 7.

10

2-in vitro activity of the dronedarone on *Leishmania major* (as a model of middle east strains)

15 The dronedarone presents a strong activity in vitro on the models of axenic amastigotes and intramacrophagic amastigotes of *Leishmania major*, with IC50 lower than 3  $\mu$ M, what places it at a level of activity similar to that of miltefosine. The intrinsic activity on the parasite itself is thus maintained when this one is protected in the phagolysosome inside the macrophage. The therapeutic index of the dronedarone defined as the CC50 on intramacrophagic amastigotes of *L. major* / IC50 is thus superior to 9.

20

These results tend to demonstrate that dronedarone has a capacity to bring a therapeutic effect on various strains (3 models tested from around the world), at concentrations similar to miltefosine, and much lower then glucantime.

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### Claims

1. Dronedarone or one of its pharmaceutically acceptable salts for use in the treatment  
5 of leishmaniasis.
2. Dronedarone for use according to claim 1 in the treatment of cutaneous leishmaniasis.
3. Dronedarone for use according to anyone of claims 1 and 2 in the treatment of  
10 leishmaniasis issued from *Leishmania amazonensis* strains.
4. Dronedarone for use according to anyone of claims 1 to 3 in the treatment of  
leishmaniasis issued from *Leishmania amazonensis* strains resistant to pentavalent  
antimonials derivatives .  
15
5. Dronedarone for use according to claim 4 wherein said pentavalent antimonials  
derivative is meglumine antimoniate
6. Dronedarone for use according to claim 1 in the treatment of leishmaniasis issued  
20 from *Leishmania donovani* strains.
7. Dronedarone for use according to claim 1 in the treatment of leishmaniasis issued  
from *Leishmania major* strains.
8. Dronedarone for use according to anyone of claims 1 to 7 wherein said  
25 pharmaceutically acceptable salt is dronedarone hydrochloride.
9. Formulation comprising dronedarone or one of its pharmaceutically acceptable salts  
for topical administration.  
30
10. Formulation according to claim 9 wherein said formulation comprises at least a  
pharmaceutically acceptable excipient
11. Formulation according to anyone of claims 9 or 10 wherein said pharmaceutically  
35 acceptable salt is dronedarone hydrochloride.

12. Formulation according to any one of claims 9 to 11 wherein said formulation is a hydro-alcoholic gel.
- 5 13. Formulation according to anyone of claims 9 to 12 wherein said pharmaceutically acceptable excipient is hydroxypropyl methylcellulose.
14. Formulation according to anyone of claims 9 to 13 for use as a medicine.
- 10 15. Formulation according to anyone of claims 9 to 14 for use in the treatment of leishmaniasis.
16. Formulation according to anyone of claims 9 to 15 for use in the treatment of cutaneous leishmaniasis.
- 15 17. Formulation according to anyone of the claims 9 to 16 for use in the treatment of leishmaniasis issued from *Leishmania amazonensis* strains.
- 20 18. Formulation according to anyone of the claims 9 to 17 for use in the treatment of leishmaniasis issued from *Leishmania amazonensis* strains resistant to pentavalent antimonials derivatives .
19. Formulation according to claim 18 wherein said pentavalent antimonials derivative is meglumine antimoniate.
- 25 20. Formulation according to anyone of the claims 9 to 16 for use in the treatment of leishmaniasis issued from *Leishmania donovani*.
21. Formulation according to anyone of the claims 9 to 16 for use in the treatment of leishmaniasis issued from *Leishmania major*.
- 30 22 Formulation according to anyone of claims 9 to 16 wherein dronedarone or one of its pharmaceutically acceptable salt may be used in a proportion of 10% by weight of the active principle in base form.
- 35 23. Association of dronedarone or one of its pharmaceutically acceptable salts and an anti-leishmaniasis agent.

24. Association according to claim 23 for use in the treatment of leishmaniasis.

25. Association according to anyone of claims 23 and 24 for use in the treatment of cutaneous leishmaniasis.

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26. Association according to anyone of claims 23 to 25 for use in the treatment of leishmaniasis issued from *Leishmania amazonensis* strains.

10 27. Association according to anyone of claims 23 to 26 for use in the treatment of leishmaniasis issued from *Leishmania amazonensis* strains resistant to pentavalent antimonials derivatives .

28. Association according to anyone of claims 23 to 27 wherein said anti-leishmaniasis agent is selected among the following agents:

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- Miltefosine or one of its pharmaceutically acceptable derivatives,
  - Amphotericin B or one of its pharmaceutically acceptable derivatives,
  - pentavalent antimonials derivatives such meglumine antimoniate.

20 29. Association according to anyone of claims 27 and 28 wherein said said pentavalent antimonials derivative is meglumine antimoniate.

30. Association according to anyone of claims 23 to 25 for use in the treatment of leishmaniasis issued from *Leishmania donovani* strains.

25 31. Association according to anyone of claims 23 to 25 for use in the treatment of leishmaniasis issued from *Leishmania major* strains.