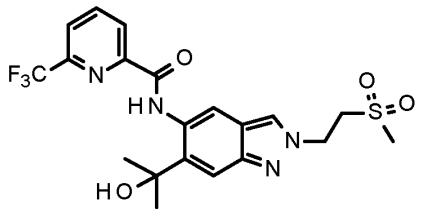
POLYMORPHIC FORM of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide

The present invention relates to crystalline forms of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide, processes for their preparation, pharmaceutical compositions comprising them, to intermediate compounds, and their use in the control of disorders.

N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)-pyridine-2-carboxamide corresponds to the compound of formula (I):



(I) .

The compound of formula (I) or its polymorphic form B of the compound of formula (I) inhibits interleukin-1 receptor-associated kinase 4 (IRAK4).

Human IRAK4 (interleukin-1 receptor-associated kinase 4) plays a key role in the activation of the immune system. Therefore, this kinase is an important therapeutic target molecule for the development of inflammation-inhibiting substances. IRAK4 is expressed by a multitude of cells and mediates the signal transduction of Toll-like receptors (TLR), except TLR3, and receptors of the interleukin (IL)-1β family consisting of the IL-1R (receptor), IL-18R, IL-33R and IL-36R (Janeway and Medzhitov, Annu. Rev. Immunol., 2002; Dinarello, Annu. Rev. Immunol., 2009; Flannery and Bowie, Biochemical Pharmacology, 2010).

Neither IRAK4 knockout mice nor human cells from patients lacking IRAK4 react to stimulation by TLRs (except TLR3) and the IL-1β family (Suzuki, Suzuki, et al., Nature, 2002; Davidson, Currie, et al., The Journal of Immunology, 2006; Ku, von Bernuth, et al., JEM, 2007; Kim, Staschke, et al., JEM, 2007).

The binding of the TLR ligands or the ligands of the IL-1β family to the respective receptor leads to recruitment and binding of MyD88 [Myeloid differentiation primary response gene (88)] to the receptor. As a result, MyD88 interacts with IRAK4, resulting in the formation of an active complex

which interacts with and activates the kinases IRAK1 or IRAK2 (Kollewe, Mackensen, et al., Journal of Biological Chemistry, 2004; Precious et al., J. Biol. Chem., 2009). As a result of this, the NF (nuclear factor)-kB signalling pathway and the MAPK (mitogen-activated protein kinase) signal pathway is activated (Wang, Deng, et al., Nature, 2001). The activation both of the NF-kB signalling pathway and of the MAPK signalling pathway leads to processes associated with different immune processes. For example, there is increased expression of various inflammatory signal molecules and enzymes such as cytokines, chemokines and COX-2 (cyclooxygenase-2), and increased mRNA stability of inflammation-associated genes, for example COX-2, IL-6, IL-8 (Holtmann, Enninga, et al., Journal of Biological Chemistry, 2001; Datta, Novotny, et al., The Journal of Immunology, 2004). Furthermore, these processes may be associated with the proliferation and differentiation of particular cell types, for example monocytes, macrophages, dendritic cells, T cells and B cells (Wan, Chi, et al., Nat Immunol, 2006; McGettrick and J. O'Neill, British Journal of Haematology, 2007).

The central role of IRAK4 in the pathology of various inflammatory disorders had already been shown by direct comparison of wild-type (WT) mice with genetically modified animals having a kinase-inactivated form of IRAK4 (IRAK4 KDKI). IRAK4 KDKI animals have an improved clinical picture in the animal model of multiple sclerosis, atherosclerosis, myocardial infarction and Alzheimer's disease (Rekhter, Staschke, et al., Biochemical and Biophysical Research Communication, 2008; Maekawa, Mizue, et al., Circulation, 2009; Staschke, Dong, et al., The Journal of Immunology, 2009; Kim, Febbraio, et al., The Journal of Immunology, 2011; Cameron, Tse, et al., The Journal of Neuroscience, 2012). Furthermore, it was found that deletion of IRAK4 in the animal model protects against virus-induced myocarditis an improved anti-viral reaction with simultaneously reduced systemic inflammation (Valaperti, Nishii, et al., Circulation, 2013). It has also been shown that the expression of IRAK4 correlates with the degree of Vogt-Koyanagi-Harada syndrome (Sun, Yang, et al., PLoS ONE, 2014).

As well as the essential role of IRAK4 in congenital immunity, there are also hints that IRAK4 influences the differentiation of what are called the Th17 T cells, components of adaptive immunity. In the absence of IRAK4 kinase activity, fewer IL-17-producing T cells (Th17 T cells) are generated compared to WT mice. The inhibition of IRAK4 is therefore suitable for prophylaxis and/or treatment of atherosclerosis, type 1 diabetes, rheumatoid arthritis, spondyloarthritis, lupus erythematosus, psoriasis, vitiligo, chronic inflammatory bowel disease and viral disorders, for example HIV (human immunodeficiency virus), hepatitis virus (Staschke, et al., The Journal of Immunology, 2009; Zambrano-Zaragoza, et al., International Journal of Inflammation, 2014).

Owing to the central role of IRAK4 in the MyD88-mediated signal cascade of TLRs (except TLR3) and the IL-1 receptor family, the inhibition of IRAK4 can be utilized for the prophylaxis and/or treatment of disorders mediated by the receptors mentioned. TLRs and also components of the IL-1 receptor family are involved in the pathogenesis of rheumatoid arthritis, metabolic syndrome, diabetes, osteoarthritis, Sjögren syndrome and sepsis (Scanzello, Plaas, et al. Curr Opin Rheumatol, 2008; Roger, Froidevaux, et al, PNAS, 2009; Gambuzza, Licata, et al., Journal of Neuroimmunology, 2011; Fresno, Archives Of Physiology And Biochemistry, 2011; Volin and Koch, J Interferon Cytokine Res, 2011; Akash, Shen, et al., Journal of Pharmaceutical Sciences, 2012; Goh and Midwood, Rheumatology, 2012; Dasu, Ramirez, et al., Clinical Science, 2012; Ramirez and Dasu, Curr Diabetes Rev, 2012; Li, Wang, et al., Pharmacology & Therapeutics, 2013; Sedimbi, Hagglof, et al., Cell Mol Life Sci, 2013; Talabot-Aye, et al., Cytokine, 2014). Skin diseases such as psoriasis, atopic dermatitis, Kindler's syndrome, allergic contact dermatitis, acne inversa and acne vulgaris are associated with the IRAK4-mediated TLR signalling pathway (Gilliet, Conrad, et al., Archives of Dermatology, 2004; Niebuhr, Langnickel, et al., Allergy, 2008; Miller, Adv Dermatol, 2008; Terhorst, Kalali, et al., Am J Clin Dermatol, 2010; Viguier, Guigue, et al., Annals of Internal Medicine, 2010; Cevikbas, Steinhoff, J Invest Dermatol, 2012; Minkis, Aksentijevich, et al., Archives of Dermatology, 2012; Dispenza, Wolpert, et al., J Invest Dermatol, 2012; Minkis, Aksentijevich, et al., Archives of Dermatology, 2012; Gresnigt and van de Veerdonk, Seminars in Immunology, 2013; Selway, Kurczab, et al., BMC Dermatology, 2013; Sedimbi, Hagglof, et al., Cell Mol Life Sci, 2013; Wollina, Koch, et al. Indian Dermatol Online, 2013; Foster, Baliwag, et al., The Journal of Immunology, 2014).

Pulmonary disorders such as pulmonary fibrosis, obstructive pulmonary disease (COPD), acute respiratory distress syndrome (ARDS), acute lung injury (ALI), interstitial lung disease (ILD), sarcoidosis and pulmonary hypertension also show an association with various TLR-mediated signalling pathways. The pathogenesis of the pulmonary disorders may be either infectiously mediated or non-infectiously mediated processes (Ramirez Cruz, Maldonado Bernal, et al., Rev Alerg Mex, 2004; Jeyaseelan, Chu, et al., Infection and Immunity, 2005; Seki, Tasaka, et al., Inflammation Research, 2010; Xiang, Fan, et al., Mediators of Inflammation, 2010; Margaritopoulos, Antoniou, et al., Fibrogenesis & Tissue Repair, 2010; Hilberath, Carlo, et al., The FASEB Journal, 2011; Nadigel, Prefontaine, et al., Respiratory Research, 2011; Kovach and Standiford, International Immunopharmacology, 2011; Bauer, Shapiro, et al., Mol Med, 2012; Deng, Yang, et al., PLoS One, 2013; Freeman, Martinez, et al., Respiratory Research, 2013; Dubaniewicz, A., Human Immunology, 2013). TLRs and also IL-1R family members are also involved in the pathogenesis of other inflammatory disorders such as Behçet's disease, gout, lupus erythematosus, adult-onset Still's disease and chronic inflammatory bowel diseases such as ulcerative colitis and Crohn's disease, and

transplant rejection, and so inhibition of IRAK4 here is a suitable therapeutic approach (Liu-Bryan, Scott, et al., Arthritis & Rheumatism, 2005; Christensen, Shupe, et al., Immunity, 2006; Cario, Inflammatory Bowel Diseases, 2010; Nickerson, Christensen, et al., The Journal of Immunology, 2010; Rakoff-Nahoum, Hao, et al., Immunity, 2006; Heimesaat, Fischer, et al., PLoS ONE, 2007; Kobori, Yagi, et al., J Gastroenterol, 2010; Shi, Mucsi, et al., Immunological Reviews, 2010; Leventhal and Schroppel, Kidney Int, 2012; Chen, Lin, et al., Arthritis Res Ther, 2013; Hao, Liu, et al., Curr Opin Gastroenterol, 2013; Kreisel and Goldstein, Transplant International, 2013; Li, Wang, et al., Pharmacology & Therapeutics, 2013; Walsh, Carthy, et al., Cytokine & Growth Factor Reviews, 2013; Zhu, Jiang, et al., Autoimmunity, 2013; Yap and Lai, Nephrology, 2013). Because of the mechanism of action of the compound of formula (I), they are also suitable for prophylactic and/or therapeutic use of the TLR and IL-1R family-mediated disorders endometriosis and atherosclerosis (Akoum, Lawson, et al., Human Reproduction, 2007; Allhorn, Boing, et al., Reproductive Biology and Endocrinology, 2008; Lawson, Bourcier, et al., Journal of Reproductive Immunology, 2008; Seneviratne, Sivagurunathan, et al., Clinica Chimica Acta, 2012; Sikora, Mielczarek-Palacz, et al., American Journal of Reproductive Immunology, 2012; Falck-Hansen, Kassiteridi, et al., International Journal of Molecular Sciences, 2013; Khan, Kitajima, et al., Journal of Obstetrics and Gynaecology Research, 2013; Santulli, Borghese, et al., Human Reproduction, 2013; Sedimbi, Hagglof, et al., Cell Mol Life Sci, 2013).

In addition to the disorders already mentioned, IRAK4-mediated TLR processes have been described in the pathogenesis of eye disorders such as retinal ischaemia, keratitis, allergic conjunctivitis, keratoconjunctivitis sicca, macular degeneration and uveitis (Kaarniranta and Salminen, J Mol Med (Berl), 2009; Sun and Pearlman, Investigative Ophthalmology & Visual Science, 2009; Redfern and McDermott, Experimental Eye Research, 2010; Kezic, Taylor, et al., J Leukoc Biol, 2011; Chang, McCluskey, et al., Clinical & Experimental Ophthalmology, 2012; Guo, Gao, et al., Immunol Cell Biol, 2012; Lee, Hattori, et al., Investigative Ophthalmology & Visual Science, 2012; Qi, Zhao, et al., Investigative Ophthalmology & Visual Science, 2014).

Because of the central role of IRAK4 in TLR-mediated processes, the inhibition of IRAK4 also enables the treatment and/or prevention of cardiovascular and neurological disorders, for example myocardial reperfusion damage, myocardial infarction, hypertension (Oyama, Blais, et al., Circulation, 2004; Timmers, Sluijter, et al., Circulation Research, 2008; Fang and Hu, Med Sci Monit, 2011; Bijani, International Reviews of Immunology, 2012; Bomfim, Dos Santos, et al., Clin Sci (Lond), 2012; Christia and Frangogiannis, European Journal of Clinical Investigation, 2013; Thompson and Webb, Clin Sci (Lond), 2013;), and also Alzheimer's disease, stroke, craniocerebral trauma and

Parkinson's disease (Brough, Tyrrell, et al., Trends in Pharmacological Sciences, 2011; Carty and Bowie, Biochemical Pharmacology, 2011; Denes, Kitazawa, Cheng, et al., The Journal of Immunology, 2011; Lim, Kou, et al., The American Journal of Pathology, 2011; Béraud and Maguire-Zeiss, Parkinsonism & Related Disorders, 2012; Denes, Wilkinson, et al., Disease Models & Mechanisms, 2013; Noelker, Morel, et al., Sci. Rep., 2013; Wang, Wang, et al., Stroke, 2013).

Because of the involvement of TLR signals and IL-1 receptor family-mediated signals via IRAK4 in the case of pruritus and pain, for example cancer pain, post-operative pain, inflammation-induced and chronic pain, there may be assumed to be a therapeutic effect in the indications mentioned through the inhibition of IRAK4 (Wolf, Livshits, et al., Brain, Behavior, and Immunity, 2008; Kim, Lee, et al., Toll-like Receptors: Roles in Infection and Neuropathology, 2009; del Rey, Apkarian, et al., Annals of the New York Academy of Sciences, 2012; Guerrero, Cunha, et al., European Journal of Pharmacology, 2012; Kwok, Hutchinson, et al., PLoS ONE, 2012; Nicotra, Loram, et al., Experimental Neurology, 2012; Chopra and Cooper, J Neuroimmune Pharmacol, 2013; David, Ratnayake, et al., Neurobiology of Disease, 2013; Han, Zhao, et al., Neuroscience, 2013; Liu and Ji, Pflugers Arch., 2013; Stokes, Cheung, et al., Journal of Neuroinflammation, 2013; Zhao, Zhang, et al., Neuroscience, 2013; Liu, Y. Zhang, et al., Cell Research, 2014).

This also applies to some oncological disorders. Particular lymphomas, for example ABC-DLBCL (activated B-cell diffuse large-cell B-cell lymphoma), mantle cell lymphoma and Waldenström's disease, and also chronic lymphatic leukaemia, melanoma and liver cell carcinoma, are characterized by mutations in MyD88 or changes in MyD88 activity which can be treated by an IRAK4 inhibitor (Ngo, Young, et al., Nature, 2011; Puente, Pinyol, et al., Nature, 2011; Srivastava, Geng, et al., Cancer Research, 2012; Treon, Xu, et al., New England Journal of Medicine, 2012; Choi, Kim, et al., Human Pathology, 2013; (Liang, Chen, et al., Clinical Cancer Research, 2013). In addition, MyD88 plays an important role in ras-dependent tumours, and so IRAK4 inhibitors are also suitable for treatment thereof (Kfoury, A., K. L. Corf, et al., Journal of the National Cancer Institute, 2013).

Inflammatory disorders such as CAPS (cryopyrin-associated periodic syndromes) including FCAS (familial cold autoinflammatory syndrome), MWS (Muckle-Wells syndrome), NOMID (neonatal-onset multisystem inflammatory disease) and CONCA (chronic infantile, neurological, cutaneous, and articular) syndrome; FMF (familial mediterranean fever), HIDS (hyper-IgD syndrome), TRAPS (tumour necrosis factor receptor 1-associated periodic syndrom), juvenile idiopathic arthritis, adult-onset Still's disease, Adamantiades-Behçet's disease, rheumatoid arthritis, osteoarthritis, keratoconjunctivitis sicca and Sjögren syndrome are treated by blocking the IL-1 signal pathway;

therefore here, too, an IRAK4 inhibitor is suitable for treatment of the diseases mentioned (Narayanan, Corrales, et al., Cornea, 2008; Henderson and Goldbach-Mansky, Clinical Immunology, 2010; Dinarello, European Journal of Immunology, 2011; Gul, Tugal-Tutkun, et al., Ann Rheum Dis, 2012; Pettersson, Annals of MedicinePetterson, 2012; Ruperto, Brunner, et al., New England Journal of Medicine, 2012; Nordström, Knight, et al., The Journal of Rheumatology, 2012; Vijmasi, Chen, et al., Mol Vis, 2013; Yamada, Arakaki, et al., Opinion on Therapeutic Targets, 2013). The ligand of IL-33R, IL-33, is involved particularly in the pathogenesis of acute kidney failure, and so the inhibition of IRAK4 for prophylaxis and/or treatment is a suitable therapeutic approach (Akcay, Nguyen, et al., Journal of the American Society of Nephrology, 2011). Components of the IL-1 receptor family are associated with myocardial infarction, different pulmonary disorders such as asthma, COPD, idiopathic interstitial pneumonia, allergic rhinitis, pulmonary fibrosis and acute respiratory distress syndrome (ARDS), and so prophylactic and/or therapeutic action is to be expected in the indications mentioned through the inhibition of IRAK4 (Kang, Homer, et al., The Journal of Immunology, 2007; Imaoka, Hoshino, et al., European Respiratory Journal, 2008; Couillin, Vasseur, et al., The Journal of Immunology, 2009; Abbate, Kontos, et al., The American Journal of Cardiology, 2010; Lloyd, Current Opinion in Immunology, 2010; Pauwels, Bracke, et al., European Respiratory Journal, 2011; Haenuki, Matsushita, et al., Journal of Allergy and Clinical Immunology, 2012; Yin, Li, et al., Clinical & Experimental Immunology, 2012; Abbate, Van Tassell, et al., The American Journal of Cardiology, 2013; Alexander-Brett, et al., The Journal of Clinical Investigation, 2013; Bunting, Shadie, et al., BioMed Research International, 2013; Byers, Alexander-Brett, et al., The Journal of Clinical Investigation, 2013; Kawayama, Okamoto, et al., J Interferon Cytokine Res, 2013; Martínez-González, Roca, et al., American Journal of Respiratory Cell and Molecular Biology, 2013; Nakanishi, Yamaguchi, et al., PLoS ONE, 2013; Qiu, Li, et al., Immunology, 2013; Li, Guabiraba, et al., Journal of Allergy and Clinical Immunology, 2014; Saluja, Ketelaar, et al., Molecular Immunology, 2014).

The prior art discloses a multitude of IRAK4 inhibitors (see, for example, Annual Reports in Medicinal Chemistry (2014), 49, 117 – 133).

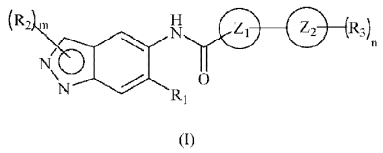
US8293923 and US20130274241 disclose IRAK4 inhibitors having a 3-substituted indazole structure. There is no description of 2-substituted indazoles.

WO2013/106254 and WO2011/153588 disclose 2,3-disubstituted indazole derivatives.

WO2007/091107 describes 2-substituted indazole derivatives for the treatment of Duchenne muscular dystrophy. The compounds disclosed do not have 6-hydroxyalkyl substitution.

WO2015/091426 describes indazoles, the alkyl group thereof substituted at position 2 by a carboxamide structure.

WO2015/104662 disloses indazole compounds of formula (I)



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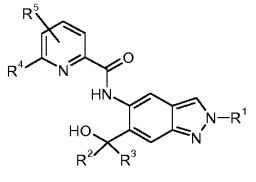
which are therapeutically useful as kinase inhibitor, particularly IRAK4 inhibitors, and pharmaceutically acceptable salts or stereoisomers thereof that are useful in the treatment and prevention of diseases or disorder, in particular their use in diseases or disorder mediated by kinase enzyme, particularly IRAK4 enzyme.

WO2016/083433, published after the priority date of the present application, describes novel substituted indazoles of the following formula



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methods for the production thereof, use thereof alone or in combinations to treat and/or prevent diseases, and use thereof to produce drugs for treating and/or preventing diseases, in particular for treating and/or preventing endometriosis and endometriosis-associated pain and other symptoms associated with endometriosis such as dysmenorrhea, dyspareunia, dysuria, and dyschezia, lymphomas, rheumatoid arthritis, spondyloarthritides (in particular psoriatic spondyloarthritis and Bekhterev's disease), lupus erythematosus, multiple sclerosis, macular degeneration, COPD, gout, fatty liver diseases, insulin resistance, tumor diseases, and psoriasis.

Accordingly, a need exists to obtain crystalline forms of the compound of formula (I) with good physiochemical properties that may be used advantageously in pharmaceutical processing and pharmaceutical compositions.

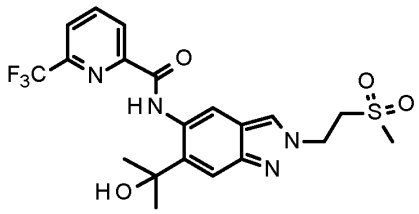
The novel IRAK4 inhibitor shall be especially suitable for treatment and for prevention of proliferative and inflammatory disorders characterized by an overreacting immune system. Particular mention should be made here of inflammatory skin disorders, cardiovascular disorders, lung disorders, eye disorders, autoimmune disorders, gynaecological disorders, especially endometriosis, and cancer.

A process was to be disclosed that would allow the production of indazole (I) on technical scale with a special focus on the following requirements:

- Scale-up/scalability of the manufacturing process
- High regioselectivity in the N2-alkylation reaction
- Avoidance of chromatographic separation and purification steps
- Final processing via crystallization
- Final adjustment of the polymorphic modification using Class 3 solvents (in accordance with FDA guidelines)

Remarkably, a process could be disclosed that meets all of the requirements mentioned above.

Surprisingly the following crystalline forms of the compound of formula (I) have been identified, which are polymorphic form A, polymorphic form B, and a pseudo-polymorphic form which is a crystalline 1,7-Hydrate. In this context, modifications, polymorphic forms and polymorphs have the same meaning. In addition, the amorphous form exists. All together, the polymorphic forms, the pseudo-polymorphic form and the amorphous form are different solid forms of the compound of formula (I).



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The compound of formula (I) in its polymorphic form B has been described in the priority application EP16167652.3, filed on 29 April 2016, of this patent application as polymorphic form A of the compound of the formula (I). According to the rules described in Joel Bernstein, *Polymorphism in molecular crystals*, Clarendon Press 2002, page 8-9, the designation and naming of polymorphs is commonly carried out according to the order of their melting points starting with that having the highest melting point named as polymorphic form A. As it becomes evident during the laboratory

tests within the last few month, that the polymorphic form A of the compound of the formula (I) as described in the priority application EP16167652.3 is that with the lower melting point compared to the other polymorphic form, we herewith correct the naming of that compound as described in EP16167652.3, filed on 29 April 2016, as form A to polymorphic form B of the compound of the formula (I).

Polymorphic form B of the compound of the formula (I) is the thermodynamically stable form. Surprisingly polymorphic form B of the compound of formula (I) shows beneficial properties over the other solid forms of the compound of formula (I) which are for example but not limited to stability (e.g. thermodynamic stability, mechanical stability, chemical stability, and/ or storage stability), compatibility over other ingredients, purity, hygroscopicity, solubility (thermodynamical and/ or kinetical), crystallization properties, habitus, bioavailability, adverse effects, pharmacokinetic behaviour, efficacy, beneficial properties during the chemical synthesis (e.g. regarding work-up or isolation which can be for example improved filterability) and/ or beneficial properties during the manufacturing of a pharmaceutical composition.

Polymorphic form B is therefore suitable and preferred over the other solid forms of the compound of formula (I) for use in the pharmaceutical field, in particular suitable for manufacturing pharmaceutical compositions, for example manufacturing of tablets containing the polymorphic form B of the compound of the formula (I).

In particular polymorphic form B of the compound of the formula (I) ensures that an undesired conversion into another form of the compound of formula (I) and an associated change in the properties as described above is prevented. This increases the safety and quality of preparations comprising of the compound of the formula (I) and the risk to the patient is reduced.

The compound of the formula (I) in the polymorphic form B can be isolated by crystallization out of solution using acetonitrile, tetrahydrofuran or acetone by evaporation at room temperature or evaporation under cooling conditions (refrigerator or freezer).

Embodiments of the present invention are not only each single crystalline form of the compound of the formula (I) which are polymorphic form A, polymorphic form B and 1,7-Hydrate of the compound of the formula (I) but also mixtures comprising two or three crystalline forms of the aforementioned.

A pharmaceutical composition according to the present invention comprises a crystalline form of the compound of the formula (I) selected from the group consisting of its polymorphic form A, its polymorphic form B, its 1,7-hydrate and a mixture thereof and further pharmaceutically acceptable excipients.

A pharmaceutical composition according to the present invention comprises preferably only one of the crystalline forms selected from the group comprising polymorphic form A, polymorphic form B and 1,7-hydrate of the compound of the formula (I) mainly and no significant fractions of another form of the compound of the formula (I). More preferably the pharmaceutical composition contains more than 85 percent by weight, more preferably more than 90 percent by weight, most preferably more than 95 percent by weight of the polymorphic form B of the compound of the formula (I) related to the total amount of all forms of the compound of the formula (I) present in the composition.

Preference is given to a pharmaceutical composition comprising the compound of the formula (I) in the polymorphic form B mainly and no significant fractions of another solid form of the compound of the formula (I), for example of another polymorphic or pseudopolymorphic form of the compound of the formula (I). The pharmaceutical composition preferably contains more than 80 percent by weight, preferably more than 90 percent by weight, most preferably more than 95 percent by weight of the polymorphic form B of the compound of the formula (I) related to the total amount of all forms of the compound of the formula (I) present in the composition.

Further preference is given to a pharmaceutical composition comprising the compound of the formula (I) in the polymorphic form A mainly and no significant fractions of another solid form of the compound of the formula (I), for example of another pseudopolymorphic form of the compound of the formula (I). The pharmaceutical composition preferably contains more than 80 percent by weight, more preferably more than 90 percent by weight, most preferably more than 95 percent by weight of the compound of the formula (I) in the polymorphic form A related to the total amount of all forms of the compound of the formula (I) present in the composition.

Further preference is given to a pharmaceutical composition comprising a 1,7-hydrate of the compound of formula (I) mainly and no significant fractions of another solid form of the compound of the formula (I), for example of another polymorphic form of the compound of the formula (I). The pharmaceutical composition preferably contains more than 85 percent by weight, more preferably more than 90 percent by weight, more preferably more than 95 percent by weight of the compound of the formula (I) as 1,7-hydrate related to the total amount of all forms of the compound of the formula (I) present in the composition.

The different forms of the compound of formula (I) can be distinguished by X-ray powder diffraction, differential scanning calorimetry (DSC), IR-, Raman-, NIR-, FIR- and ^{13}C-solid-state-NMR-spectroscopy.

The different forms of the compound of formula (I) have been characterized by X-ray powder diffraction, DSC- and TGA-Thermogram:

FIGURE 1: X-Ray powder diffractogram of polymorphic form B of compound (I)

FIGURE 2: X-Ray powder diffractogram of polymorphic form A of compound (I)

FIGURE 3: X-Ray powder diffractogram of 1,7-hydrate of compound (I)

FIGURE 4: DSC- and TGA-Thermogram of polymorphic form B of compound (I)

FIGURE 5: DSC- and TGA-Thermogram of polymorphic form A of compound (I)

FIGURE 6: DSC- and TGA-Thermogram of 1,7-hydrate of compound (I)

The polymorphic form B of the compound of formula (I) can be characterized unambiguously by a X-Ray powder diffractogram (at 25°C and with copper K alpha 1 as radiation source) which displays at least the following reflections: 9.7, 10.1, 15.4, preferably at least the following reflections: 9.7, 10.1, 15.4, 16.1, 20.2, more preferably at least the following reflections: 9.7, 10.1, 15.4, 16.1, 20.2, 22.3, most preferably at least the following reflections: 9.7, 10.1, 15.4, 16.1, 20.2, 22.3, 25.2, each quoted as 2Theta value ± 0.2°. The compound of formula (I) in the polymorphic form B can also be characterized unambiguously by the X-Ray powder diffractogram (at 25°C and with copper Kalpha 1 as radiation source) as shown in Figure 1.

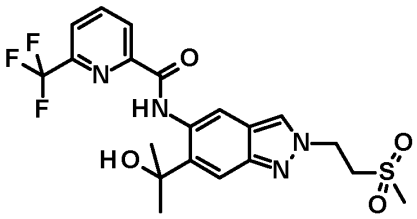
The polymorphic form A of the compound of formula (I) can be characterized unambiguously by a X-Ray powder diffractogram (at 25°C and with copper K alpha 1 as radiation source) which displays at least the following reflections: 9,2; 9,8; 19,3; preferably at least the following reflections: 9.2, 9.8, 19.3, 20.4, 20.7, more preferably at least the following reflections: 9.2, 9.8, 19.3, 20.4, 20.7, 21.6, most preferably at least the following reflections: 9.2, 9.8, 19.3, 20.4, 20.7, 21.6, 21.7, 23.1, 23.2, each quoted as 2Theta value ± 0.2°. The compound of formula (I) in the polymorphic form A can also be characterized unambiguously by the X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) as shown in Figure 2.

1,7-hydrate of the compound of formula (I) can be characterized unambiguously by a X-Ray powder diffractogram (at 25°C and with copper K alpha 1 as radiation source) which displays at least the

following reflections: 10,6; 11,8; 14,5; preferably at least the following reflections: 10.6, 11.8, 14.5, 14.9, 15.1, more preferably at least the following reflections: 10.6, 11.8, 14.5, 14.9, 15.1, 17.6, 18.7, most preferably at least the following reflections: 10.6, 11.8, 14.5, 14.9, 15.1, 17.6, 18.7, 19.8, each quoted as 2Theta value ± 0.2°. The 1,7-hydrate of the compound of formula (I) can also be characterized unambiguously by the X-Ray powder diffractogram (at 25°C and with copper K alpha 1 as radiation source) as shown in Figure 3.

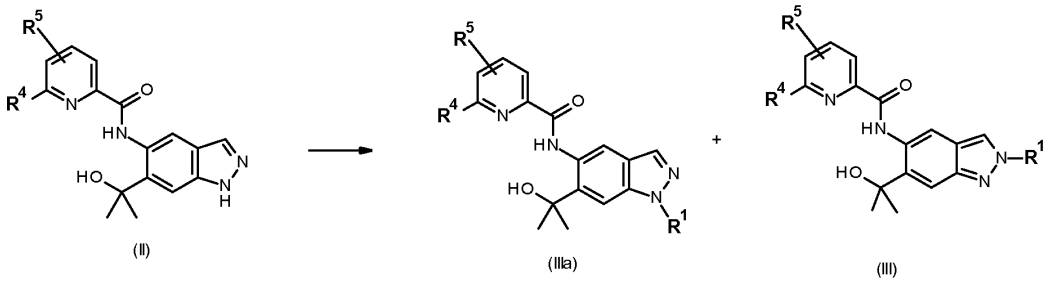
Process for preparing:

The preparation of compound (I) via a surprisingly highly selective alkylation on N2 is described in the following:



(I)

Preparations of N2-substituted indazoles have been previously described in the literature. These procedures, however, have considerable disadvantages rendering them unsuitable for technical scale. It is possible to selectively prepare N2-substituted indazoles via complex sequences of synthetic steps, which involve no direct alkylation step. These sequences, however, are long and tedious and involve considerable losses ultimately resulting in a low total yield. Therefore, synthetic routes which allow a direct preparation of N2-substituted indazoles from 1H-indazole precursors via direct and selective alkylation at N2 are most interesting. At the attempt of directly alkylating the 1H-indazole precursor of the general formula (II), generally a mixture made up of the N1- (IIIa) and N2-alkylated (III) regioisomers is obtained.



(II) (IIIa) (III)

Indazole and its derivatives, a typical class of aromatic N-heterocycles, have sparked significant interest in synthetic and medicinal chemistry due to their diverse biological activities. Furthermore, diverse heterocyclic structures could be accessed from indazole-derived N-heterocyclic carbenes. Among indazoles, N1/N2-substituted indazoles are widely used as anticancer, anti-inflammatory, anti-HIV, and antimicrobial drugs. Generally, the synthesis of N2-substituted indazoles involves cyclization procedures from miscellaneous starting materials. Unfortunately, general methodologies remain scarce in the literature. Therein, only moderate yields were obtained.

With respect to the current state of technology, several publications are known and will be discussed in the following section. None of the published procedures feature reaction conditions that lead to a direct N2-selective alkylation using methyl vinyl sulfone as alkylating agent. There is either no conversion observed or the selectivity and yield are low. The problem of the prior art procedures consists in the use of relatively simple alkylating agents bearing no labile functional groups. These agents are mostly attached to the 1H-indazole via nucleophilic substitution of their halides, tosylates, triflates or mesylates. When more functionalized moieties are used, yield and selectivity decrease dramatically. In the following section, the reasons are presented why these prior art procedures are not applicable to the challenge at hand:

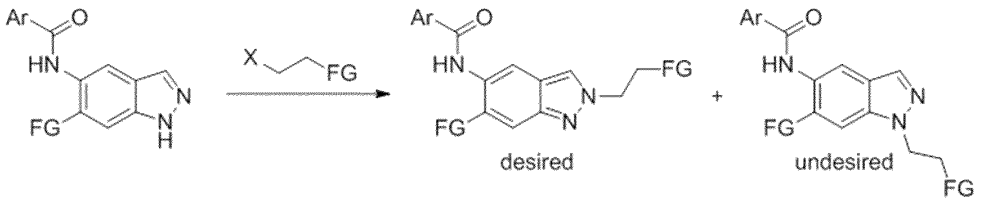
1. WO 2011/043479: The reactions are carried out in THF at reflux (see scheme 2). This does not work for the case at hand (methyl vinyl sulfone). The preparation of the corresponding triflate from e.g. the alcohol is not possible, as its decomposition occurs instantly. In addition, only a simple substrate with no functionality in the side-chain was used.

2. S. R. Baddam, N. U. Kumar, A. P. Reddy, R. Bandichhor, *Tetrahedron Lett.* **2013**, 54, 1661: Only simple indazoles without functional groups were used in the reaction. Only methyl trichloroacetimidate was used as alkylating agent. Attempts to transfer acid-catalyzed conditions to the selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed. This procedure cannot easily be scaled up.

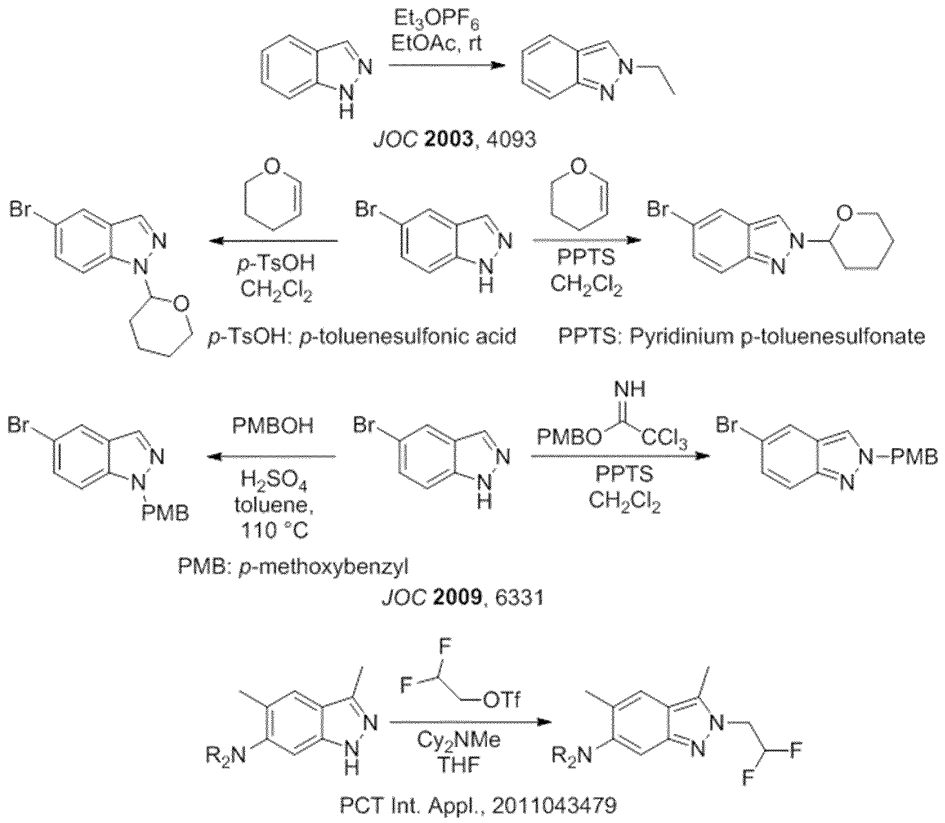
3. Q. Tian, Z. Cheng, H. H. Yajima, S. J. Savage, K. L. Green, T. Humphries, M. E. Reynolds, S. Babu, F. Gosselin, D. Askin, Org. *Process Res. Dev.* **2013**, 17, 97: The preparation of a THP-ether with preference for N2 of the indazole is presented. This reaction proceeds via a different mechanism and does not represent a general method, since the THP-ether product cannot be easily converted further. Furthermore, selective methods for protection of indazoles using p-methoxybenzyl derivatives under acidic conditions are presented. Attempts to transfer these conditions to the selective introduction of a methyl ethyl sulfone side at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed.

4. D. J. Slade, N. F. Pelz, W. Bodnar, J. W. Lampe, P. S. Watson, *J. Org. Chem.* **2009**, 74, 6331: THP-ether and PMB-protection using acidic conditions (PPTS: pyridinium para-toluenesulfonate), see scheme 2; attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed.

5. M. Cheung, A. Boloor, J. A. Stafford, *J. Org. Chem.* **2003,** 68, 4093: Highly reactive and highly carcinogenic Meerwein salts were used as alkylating agents (see scheme 2). This method only comprises simple non-functionalized ethyl and methyl Meerwein salts. The reaction proceeds in polar ethyl acetate at ambient temperature. These conditions could not be transferred to selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone.



Scheme 1: N-alkylation of 1H-indazoles



Scheme 2: N-alkylation methods of indazoles known from prior art

6. M.-H. Lin, H.-J. Liu, W.-C. Lin, C.-K. Kuo, T.-H. Chuang, *Org. Biomol. Chem.* **2015**, *13*, 11376: The procedure is N2-selective; however, it cannot be scaled up with Ga and Al metal being used in stoichiometric amounts. Under the described reaction conditions, Broensted acids are formed which react with the corresponding metals to give hydrogen gas. Only relatively simple substrates are used as alkylating agents (no sulfone group). When more functionalized substrates were used, a significant decrease in yield was observed. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed.

7. G. Luo, L. Chen, G. Dubowchick, *J. Org. Chem.* **2006**, *71*, 5392: 2-(Trimethylsilyl)ethoxymethyl chloride (SEM-Cl) in THF was used for substitution on N2 of indazoles. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed. The corresponding products described in this publication are ethers and are not related to our target molecule. The use of highly carcinogenic 2-(trimethylsilyl)ethoxymethyl chloride (SEM-

Cl) as well as benzyloxymethyl chloride (BOM-Cl) does not represent a scalable option for obtaining the target compound.

8. A. E. Shumeiko, A. A. Afon'kin, N. G. Pazumova, M. L. Kostrikin, *Russ. J. Org. Chem.* **2006**, *42*, 294: Only very simple substrates were used in this method. No significant selectivity is reported. A slight preference for N1-alkylation at the indazole was observed.

9. G. A. Jaffari, A. J. Nunn, *J. Chem. Soc. Perkin 1* **1973**, 2371: Very simple substrates and only methylation agents were used. A more complex substrate as e.g. a combination of formaldehyde with protonated methanol resulted in only N1-substituted product (ether).

10. V. G. Tsypin et al., *Russ. J. Org. Chem.* **2002**, *38*, 90: The reaction proceeds in sulfuric acid and chloroform. Only conversions of simple indazoles with adamanthyl alcohol as sole alkylating agent are described. These conditions could not be transferred to the selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone.

11. S. K. Jains et al. *RSC Advances* **2012**, *2*, 8929: This publication features an example of N-benzylation of indazoles with low selectivity towards N1-substitution. This KF-/alumina-catalyzed method cannot be used efficiently for the synthesis of N2-substituted indazoles. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

12. L. Gavara et al. *Tetrahedron* **2011**, *67*, 1633: Only relatively simple substrates were used. The described acidic THP-ether formation and benzylation in refluxing THF are not applicable to our substrate. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

13. M. Chakrabarty et al. *Tetrahedron* **2008**, *64*, 6711: N2-alkylation was observed but N1-alkylated product was obtained preferentially. The described conditions of using aqueous sodium hydroxide and phase transfer catalyst in THF are not applicable to 2-substituted indazoles. Attempts to transfer these conditions to our system (methyl vinyl sulfone) failed.

14. M. T. Reddy et al. *Der Pharma Chemica* **2014**, 6, 411: The reaction proceeds in the corresponding alkylating agent as solvent. Only the use of highly reactive ethyl bromoacetate as alkylating agent is reported. There are no data on the selectivity. These conditions are not applicable to a selective synthesis of N2-substituted indazoles. Attempts to transfer these

conditions to selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed.

15. S. N. Haydar et al. *J. Med. Chem.* **2010**, *53*, 2521: Only simple non-functionalized alkyl groups are described (methyl, isopropyl, isobutyl). Cesium carbonate was used as base and the reaction resulted in a mixture of N1- and N2-alkylated products. These conditions are not applicable to compounds as 2-indazoles. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

16. Zh. V. Chirkova et al. *Russ. J. Org. Chem.* **2012**, 48, 1557: In this method, relatively simple substrates are converted with potassium carbonate as base in DMF. Mixtures of N1- and N2-alkylated products are obtained. The conditions are not applicable to a selective synthesis of N2-substituted indazoles. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

17. C. Marminon et al. *Tetrahedron* **2007**, *63*, 735: The *ortho*-substituent R in position 7 at the indazole directs the alkylation towards N2 via shielding N1 from electrophilic attacks. The conditions, sodium hydride as base in THF, are not applicable to a selective synthesis of N2-substituted indazoles as they preferentially result in alkylation at N1 in absence of a substituent in position 7 of the indazole. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

18. D. A. Nicewicz et al. *Angew. Chem. Int. Ed.* **2014**, *53*, 6198: Only simple substrates were used. This method describes a photochemical reaction that cannot easily be scaled up and is not applicable to a general, selective synthesis of N2-substituted indazoles Very specific styrene derivatives are used under radical reaction conditions. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

19. A. Togni et al. *Angew. Chem. Int. Ed.* **2011**, *50*, 1059: This publication solely describes a special type of substituent (hypervalent iodine as trifluoromethylation reagent in combination with acetonitrile). This special case is not applicable to a general, selective synthesis of N2-substituted indazoles.

20. L. Salerno et al. *European J. Med. Chem.* **2012**, *49*, 118: This publication describes the conversion of indazoles in an α–bromoketone melt. The reaction conditions cannot be transferred to a selective synthesis of N2-substituted indazoles. Attempts to transfer these conditions to the selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

21. K. W. Hunt, D. A. Moreno, N. Suiter, C. T. Clark, G. Kim, *Org. Lett.* **2009**, *11*, 5054: This publication essentially describes an N1-selective alkylation method with addition of different bases. Simple substrates were used. Attempts to transfer these conditions to the selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

22. J. Yang et al. *Synthesis* **2016**, *48*, *48*, 1139: This publication describes an N1-selective base-catalyzed aza-Michael reaction. No substitution at N2 was observed. Attempts to transfer these conditions to the selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

23. P. R. Kym et al. *J. Med. Chem.* **2006**, *49*, 2339: Essentially N1-alkylations are described. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

24. A. J. Souers et al. *J. Med. Chem.* **2005**, *48*, 1318: This publication also describes the use of potassium carbonate as base. This method proceeds mainly with preference for substitution at N1 and is therefore not applicable to a selective synthesis of N2-substituted indazoles. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

25. P. Bethanamudi et al. *E-Journal of Chemistry* **2012**, *9*, 1676: The use of ionic liquids along with potassium carbonate as base results in mixtures of N1- and N2-alkylated indazoles with low yields. The selectivity shows a tendency towards substitution at N1. The use of ionic liquid cannot be transferred to our system. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2-position of an indazole core structure via reaction with methyl vinyl sulfone failed.

26. S. Palit et al. *Synthesis* **2015**, 3371: The reaction described herein is essentially non-selective with a slight preference of substitution at N1 of the indazole. Only simple, non-functionalized

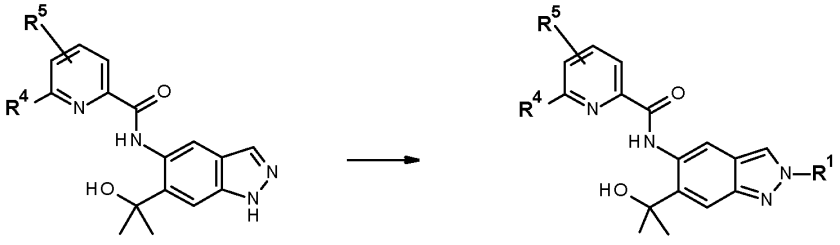
alkyl groups were used. Sodium hydride and similarly strong bases were used. Attempts to transfer these conditions to selective introduction of a methyl ethyl sulfone side chain at the N2 position of an indazole core structure via reaction with methyl vinyl sulfone failed.

It was shown that the compound of the formula (I) can be synthesized analogously to methods previously published in the literature via e.g. direct alkylation using 2-bromoethyl methyl sulfone. However, a mixture of N1- and N2-alkylated products was obtained with a preference for the N1-regioisomer (N1 : N2 = ca. 2 : 1). Desired N2-alkylated indazole of formula (I) could also be obtained in a very low yield as described in WO2016/083433, published after the priority date of the present application, with the following reaction procedure:

160 mg (0.44 mmol) of N-[6-(2-hydroxypropan-2-yl)-1H-indazol-5-yl]-6-(trifluoromethyl)pyridine-2-carboxamide (Intermediate 5-1) were suspended together with 182 mg of potassium carbonate and 36 mg of potassium iodide in 1.0 ml of DMF, and the mixture was stirred at room temperature for 15 min. Then, 123 mg of 2-bromoethyl methyl sulfone were added and the mixture was stirred at room temperature overnight. Water was added, the mixture was extracted twice with ethyl acetate and the extracts were washed with saturated aqueous sodium chloride solution, filtered through a hydrophobic filter and concentrated. Purification of the residue by preparative HPLC gave 20 mg (9.7 % yield) of the title compound.

Consumptive preparative HPLC proved indispensable for an efficient separation of the N1-/N2-regioismers. The aim of this new inventive process consists in avoiding HPLC separation via achieving a better selectivity in the reaction in favour of substitution at N2 followed by a new inventive recrystallization procedure.

The present invention provides a process for preparing compounds of the general formula (III) from compounds of the general formula (II)



(II) (III)

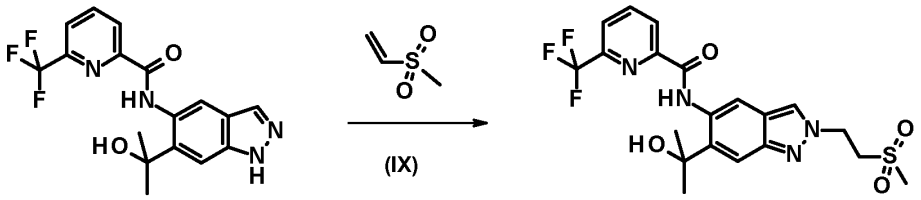
in which

R^1 2-(methylsulfonyl)ethyl;

R^4 is difluoromethyl, trifluoromethyl or methyl; and

R^5 is hydrogen or fluorine;

with preferably R^4 = trifluoromethyl and R^5 = H:



(V) (I)

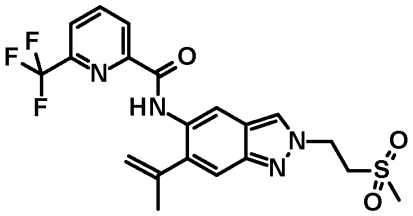
Unexpectedly, we found that methyl vinyl sulfone (IX) can replace the corresponding alkyl halide in the reaction. The use of vinyl sulfones for alkylation of indazoles at N2 is surprisingly unprecedented and therefore highly inventive. Upon reaction of compounds of the general formula (II) with methyl vinyl sulfone in toluene, optionally with addition of an organic base, such as N,N-diisopropylethylamine or triethylamine, the desired N2-isomer according to formulas (III) and (I) is obtained with very high selectivity. The selectivity in the reaction mixture was found to be in between 8:1 to 10:1 in favor of the N2-alkylated product (III) as well as (I). The undesired N1-substituted by-product remained mainly in the mother liquor after work-up of the reaction mixture (mostly < 2 % after crystallization).

The reaction works without the use of an additional base. The compound of the general formula (II) or (V) is placed in a reaction vessel. 1 - 2 equivalents of methyl vinyl sulfone are added and the reaction mixture is heated at reflux in toluene (ca. 110°C internal temperature). The reaction can be performed using 5 to 30 volumes of toluene relative to the amount of starting material (II) or (V). Preferably, the reaction is run with 8 to 15 volumes and best with 10 volumes of toluene. The time of the reaction spans 12 to 100 h. It is run preferably between 48 to 72 h. In some cases, it has proven advantageous to add the methyl vinyl sulfone in portions to the reaction mixture, e.g. start with 1 equivalent and then add 0.3 equivalents after 24 h and further 0.3 equivalents after 48 h.

Optionally, the reaction works with catalytic amounts of an organic auxiliary base, e.g. N,N-diisopropylethylamine. The compound of the general formula (II) or (V) is placed in a reaction vessel along with the solvent (toluene or xylene) and catalytic amounts of an orqanic base.

An auxiliary organic base, e.g. N,N-diisopropylethylamine, N,N-dicyclohexylamine or triethylamine can be added with amounts between 0.01 and 1 equivalent. The reaction proceeds with 0.01 to 0.1 equivalents of base.

It is noteworthy and certainly surprising that using chloro- or ethylbenzene as solvent at the same reaction temperature or xylene as solvent at higher reaction temperature, alkene (IV) was obtained in higher amounts via elimination of water. Strikingly, this elimination was observed in only very small amounts when toluene was used as solvent. Therefore, toluene must be considered as an inventive solvent with unique and completely unanticipated properties regarding this specific reaction. The formation of (IV) was also found to depend on the quality of (V). When (V) was used that had a higher than usual water content (1 wt% instead of <0.5 wt%), a more significant amount of (IV) was obtained in the reaction. It is noteworthy, that formation of the elimination product (VI) can be efficiently suppressed by removing excess water from (V) via azeotropic distillation with toluene and by addition of catalytic amounts of an organic base, in particular N,N-diisopropylethylamine.



(IV)

Isolation procedure: After completion of the reaction, toluene can be partly distilled off the reaction mixture. Subsequently, a second solvent, such as methyl *tert*-butyl ether (MTBE) or diisopropylether (preferably methyl *tert*-butyl ether) can be added to the reaction mixture. Upon addition of the respective solvent, the product precipitates almost quantitatively from the mixture. In some cases, it proved useful to seed the mixture with small amounts of crystals in order to obtain a reproducible crystallization. After cooling and prolonged stirring of the resulting suspension, the product is isolated via filtration, washed with solvent and dried at 50 to 60°C under vacuum resulting typically in 59 to 67% yield. The purity of the crude product typically amounts to 95 to 97 % (area) with less than 2 % (area) of N1-regioisomer.

It must be emphasized that the reaction of a substituted vinyl sulfone for a directed highly selective preparation of N2-functionalized indazoles is novel, without precedence in the literature and therefore a scientifically highly significant invention for the preparation of such substitution patterns. The preparation of GMP material, which will also be used in clinical trials, requires an additional purification step. Moreover, since the active pharmaceutical ingredient will be used for production of a pharmaceutical composition, such as a tablet, a procedure is required that reproducibly furnishes the identical crystal habit. Surprisingly, this could be realized using ethanol or isopropanol as solvent for recrystallization. Ethanol is the preferred solvent. The compound is therefore first dissolved in

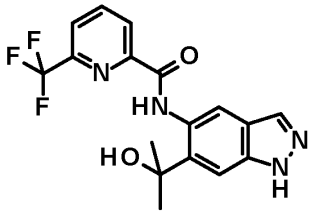
acetone and subsequently passed through a particle filter (GMP filtration). Then, a solvent swap from acetone to ethanol is performed via distillation. Distillation is continued until a final volume of 6 to 7 volumes of ethanol relative to the input material is reached. The distillation is cancelled when the boiling point of ethanol has been reached (ca. 77-78 °C) ensuring that all acetone was distilled off. The mixture is then cooled, stirred and the crystallized product is isolated via filtration and dried under vacuum at elevated temperature. The yield of the crystallization is typically > 90%. Product that is obtained from this crystallization procedure possesses the desired polymorphism properties required for preparation of a pharmaceutical composition, such as a tablet. The product displays a very high purity as well as a very high content. The most important analytical data for typical batches are given in Table 1:

Table 1: Analytical data of batches examples as shown in Table 7

Purity (HPLC)	≥ 99% (area)
Content (assay for use)	≥ 97.7% (weight)
Ethanol	< 0.25% (weight)
Pd	< 1 ppm

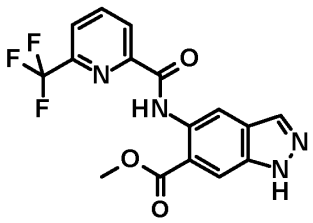
The polymorph obtained via the above described crystallization procedure displays good stability during storage. It can also be easily micronized without losing its crystal properties.

The preparation of compounds according to the general formula (II) as well as (V) is described in WO 2015/091426. This new inventive process focuses on the compound shown by formula (V):



(V)

In the published patent application WO 2015/091426, the compound according to formula (V) is prepared via reaction of the methyl ester compound according to formula (VI):



(VI)

using a solution of methylmagnesium bromide in diethylether. After work-up, the crude product is subjected to a column chromatographic purification furnishing compound according to formula (V) in 45 % yield.

WO2016/083433, published after the priority date of the present application, describes a synthesis route for the preparation of the compound according to formula (V) as well, starting from the compound according to formula (VI) by a Grignard reaction by using suitable alkylmagnesium halides, for example methylmagnesium chloride or methylmagnesium bromide in THF or in diethyl ether or else in mixtures of THF and diethyl ether.

This procedure is not suitable for production of the compound of formula (V) on technical scale due to the following drawbacks:

- The use of diethylether must be avoided due to its low ignition point and its highly explosive potential.
- The relatively costly methylmagnesium bromide was used instead of the more common methylmagnesium chloride, which is easier to procure.
- Chromatographic separations should be avoided on technical scale, as they usually require a massive uneconomical consumption of organic solvents.
- No crystallization procedure has been described. According to the usual practice in research laboratories, the compound of formula (V) was evaporated until dryness. This operation is not feasible on technical scale.
- The yield is unsatisfactory: for technical purposes, a yield of at least 75 % should be achieved.

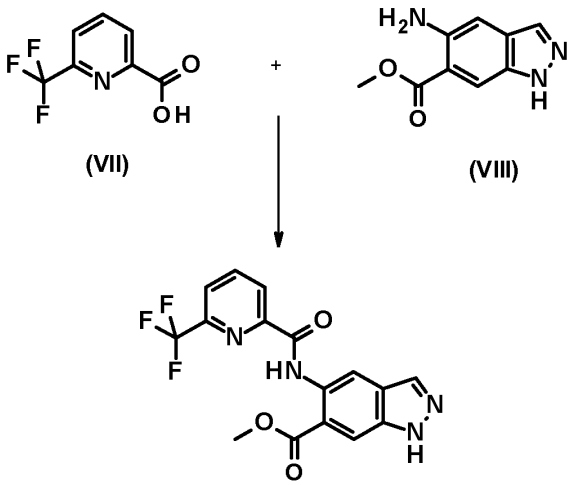
Surprisingly, it was found that the compound of formula (V) could be prepared with a significantly higher yield when methylmagnesium chloride and lithium chloride (2:1) in THF were used instead. The reactions proceeded with less byproducts which, using the method described in WO 2015/091426 and WO2016/083433 as well, had to be removed via tedious column chromatography. The reaction was found to proceed best with THF as solvent. 6 to 10 equiv.

methylmagnesium chloride (ca. 3 M in THF) and 3 to 5 equivalents lithium chloride are stirred and kept at -10 to 0°C. Within 1 to 3 h, preferably 2 h, the compound according to formula (VI) is dropped to the mixture as solution in THF. The reaction mixture is stirred for 5 to 30 min at the indicated temperature range (-10 °C to 0 °C) and subsequently quenched by being poured into water. The resulting mixture is stirred vigorously. The pH of the mixture is then adjusted to app. 4 via addition of a mineral or organic acid (preferably citric acid) and ethyl acetate is added. Phases were separated and the organic phase was washed several times with brine (aqueous sodium chloride solution). The resulting organic solution was subjected to a solvent swap with toluene via distillation. During this process, the compound according to formula (V) started to crystallize and could be isolated via filtration. The precipitate was dried at elevated temperature (50 - 60°C) under vacuum. Typically, yields at this stage were in the range of 80 to 96% and purities between 95 to 99 area% (HPLC).

For the preparation of material with **c**urrent **g**ood **m**anufacturing **p**ractice (cGMP) quality, it proved beneficial to finally stir this product in a mixture of isopropanol/water (1 : 1; 2 to 10 volumes relative to input material). The material is stirred for 1 to 5 h, preferably 3 h. It is then filtrated and washed twice with small amounts of a 1 : 1 isopropanol/water mixture. The product is dried at elevated temperature (50 - 60 °C) under vacuum. Typically, yields > 90% and purities > 97 area% (HPLC) are achieved.

In the following examples in the experimental section, a variant (see example #2, variant #3) is also described in which, after treatment with activated charcoal, a solvent swap directly to isopropanol is performed. The product is crystallized by addition of water. In this way, the product is directly obtained with very high purity.

The preparation of the compound according to formula (VI) has also been described in the patent application WO 2015/091426. Thereby, 6-(trifluoromethyl)pyridine-2-carboxylic acid (VII) (CAS no.: 21190-87-4) was coupled with the aniline-like compound of formula (VIII) (methyl-5-amino-1H-indazol-6-carboxylate; CAS no.: 1000373-79-4) using 1-[bis(dimethylamino)methylene]-1H-1,2,3-triazolo[4,5-b]pyridinium 3-oxid hexafluorophosphate (CAS no.: 148893-10-1) as coupling agent. Amide (VI) was obtained with 84% yield.



(VII) (VIII)

(VI)

Due to process safety reasons, an up-scaling of uronium-based coupling reagents is not possible because of their explosive potential. Therefore, an alternative coupling method had to be found.

The safe and scalable method for the preparation of amide-like compound of formula (VI) is based on the use of T3P (2,4,6-tripropyl-1,3,5,2,4,6-trioxatriphosphorinane-2,4,6-trioxide; CAS no.: 68957-94-8) as coupling agent.

The reaction proceeds smoothly and furnishes amide-like compound of formula (VI) with high yields. In a one-pot process, carboxylic acid-like compound of formula (VII) (best used with a slight shortage relative to aniline (VIII), ca. 0.90 - 0.95 equivalents) is placed along with 1.5 equivalents N,N-diisopropylethylamine in 16 volumes THF. Subsequently, 2 equivalents T3P (50 w% solution in ethyl acetate) are slowly added at 0 to 5 °C. The reaction mixture is additionally stirred for 2 to 4 h, preferably 2 h at 0 to 5 °C.

The mixture was then quenched with water, its pH adjusted with sodium carbonate aq. solution to app. 7.4 and the THF/ethyl acetate mixture was largely distilled off (200 mbar, 45 - 50 °C internal temperature). Subsequently, water and ethanol were added and the pH was adjusted to app. 7.0 by adding sodium carbonate aq. solution. The mixture was stirred 1 to 5 h, preferably 1 to 2 h, at 50°C, then cooled to 20 to 25°C and stirred for 10 to 30 min. The product was isolated via filtration and subsequently washed with a mixture of ethanol and water and finally dried under vacuum at 45°C. With this process, typically very high yields between 95 to 96% were obtained. The purity was in all cases > 98 area% (HPLC).

In some cases, especially when aniline-like compound of formula (VIII) of poor optical quality (e.g. dark brown color) was used as starting material, it proved useful to perform a treatment with activated charcoal. This procedure is described in the following section:

Crude amide (VI) was dissolved in a mixture of methanol and THF (2 : 1) and activated charcoal was added. The mixture was heated to 60 to 65°C for 1 to 1.5 h. The activated charcoal was filtered off and the filtrate was concentrated (down to 2 volumes relative to input material). Water was added and the product precipitated, was filtered, washed and dried at 55 to 60 °C (under vacuum).

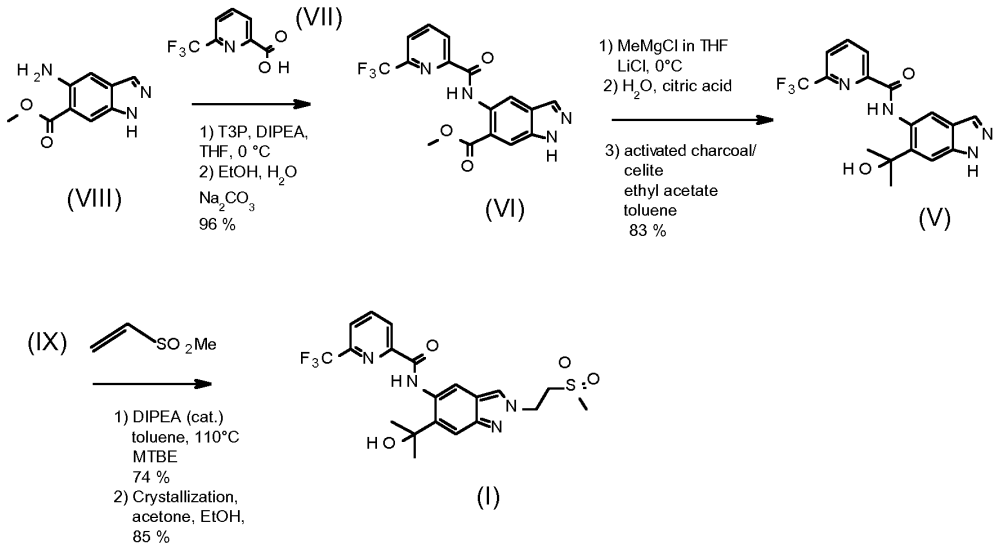
Synthesis of compounds of formulas (VII) and (VIII) have been described in the literature and both are commercially available in large quantities.

For compound according to formula (VII): Cottet, Fabrice; Marull, Marc; Lefebvre, Olivier; Schlosser, Manfred, European Journal of Organic Chemistry, 2003 , 8 p. 1559 – 1568; Carter, Percy H.; Cherney, Robert J.; Batt, Douglas G.; Duncia, John V.; Gardner, Daniel S.; Ko, Soo S.; Srivastava, Anurag S.; Yang, Michael G. Patent: US2005/54627 A1, 2005 ; Ashimori; Ono; Uchida; Ohtaki; Fukaya; Watanabe; Yokoyama Chemical and Pharmaceutical Bulletin, 1990 , vol. 38, 9 p. 2446 – 2458.

For compound according to formula (VIII): Nissan Chemical Industries, Ltd.; CHUGAI SEIYAKU KABUSHIKI KAISHA, EP2045253 A1, 2009.

Evaluation of the total process:

Scheme 2 depicts the total synthesis of pure product of formula (I) from aniline-like compound of formula (VIII). Product of formula (I) is received with a purity of > 99 area % (HPLC). When calculating with the best yields achieved for each step, a total yield of 50% is obtained. This also includes the installation of the final crystal form.



Scheme 2: Total synthesis of pure product of formula (I) from the aniline-like compound according to formula (VIII)

When comparing this total yield with the published prior art data:

1. amide coupling (preparation of compound according to formula (VI)): 84% yield;
2. Grignard reaction followed by chromatographic purification: 45% yield;
3. alkylation with 2-bromoethyl methyl sulfone analogously to methods known in the literature followed by chromatographic purification: 9.68% yield;

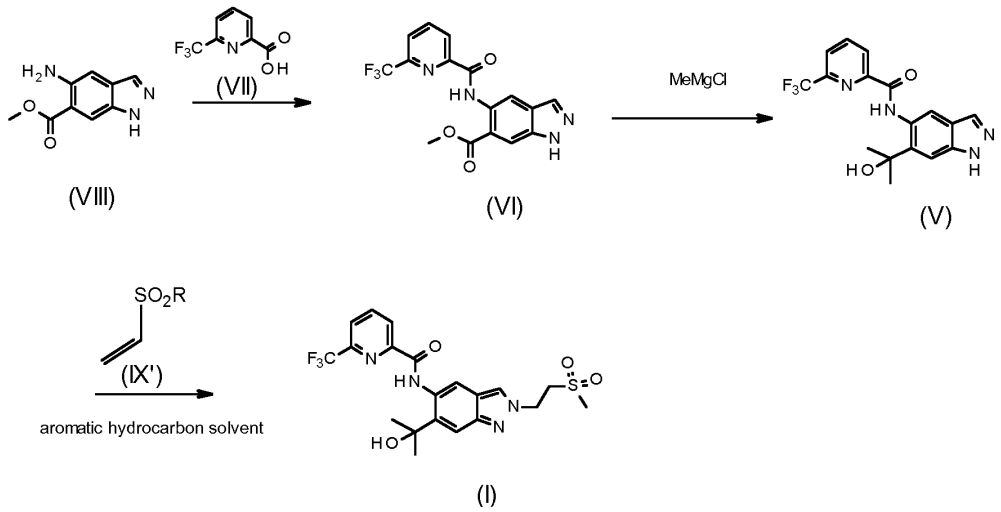
the advantages of the new process become very clear:

With the method known from the prior art and as described above, a total yield of only 3.7% could be achieved with the installation of the final crystal form not included.

To conclude, the new inventive process furnishes compound according to formula (I) with a > 13 times higher total yield as compared to the prior art. It, moreover, includes the directed and reproducible preparation of the targeted polymorph for production of a pharmaceutical composition, such as a tablet.

It must be emphasized that the reaction of a substituted vinyl sulfone for a directed highly selective preparation of N2-functionalized indazoles is novel, without precedence in the literature and therefore a highly significant invention for the preparation of such substitution patterns.

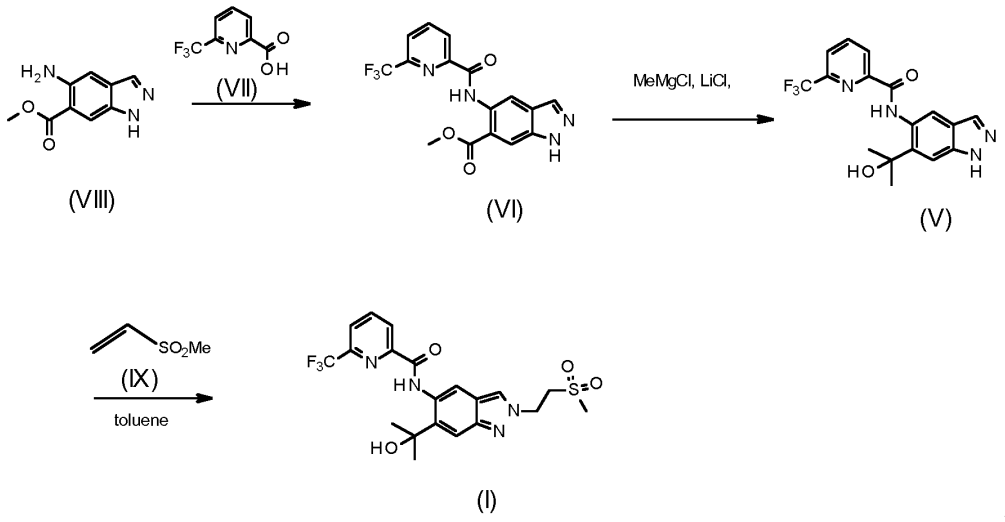
Hence, in a first aspect, the present invention relates to a method of preparing a compound of formula (I) via the following steps shown in reaction scheme IA, *vide infra*:



Scheme IA: Preparation of compound of formula (I) from compound of formula (VIII) as starting material

in which R represents an alkyl group, such as a methyl, ethyl or n-propyl group for example, or an aryl group, such as a phenyl group for example, and aromatic hydrocarbon solvent is a solvent such as toluene or xylene for example.

In an embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I) via the following steps shown in reaction scheme I, *vide infra*:



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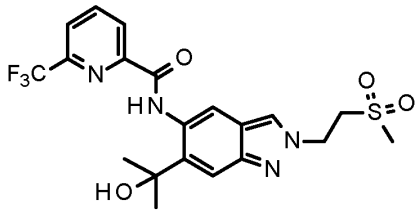
Scheme I: Preparation of compound of formula (I) from compound of formula (VIII) as starting material

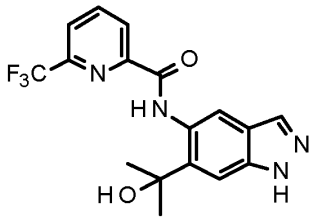
In an embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I):



(I)

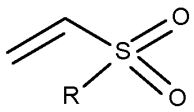
comprising the following step (A):

wherein a compound of formula (V):



(V)

is allowed to react with a vinyl sulfone compound of formula (IX'):



(IX')

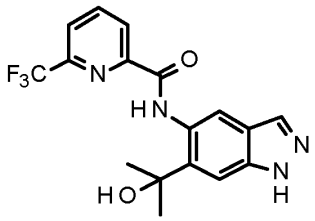
in which R represents an alkyl group, such as a methyl, ethyl or n-propyl group for example, or an aryl group, such as a phenyl group for example,

optionally in an aromatic hydrocarbon solvent, such as toluene or xylene for example, preferably at the reflux temperature of said solvent,

thereby providing said compound of formula (I).

In an embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I) as described *supra*, wherein said aromatic hydrocarbon solvent is toluene.

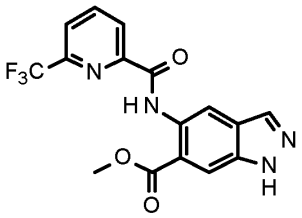
In an embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I) as described *supra*, wherein said compound of formula (V):



(V)

is prepared by the following step (B):

wherein a compound of formula (VI):



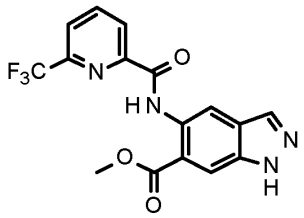
(VI)

is allowed to react with a reductive methylating agent, such as a methylmetallic agent, such as a methylmagnesium halide, such as methylmagnesium chloride for example,

optionally in the presence of an alkali metal halide, such as lithium chloride for example,

thereby providing said compound of formula (V).

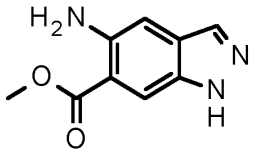
In an embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I) as described *supra*, wherein said compound of formula (VI):



(VI)

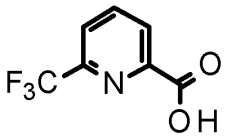
is prepared by the following step (C):

wherein a compound of formula (VIII):



(VIII)

is allowed to react with a compound of formula (VII):



(VII)

optionally in the presence of an organic base, particularly a weak organic base, such as a tertiary amine, such as N,N-diisopropylethylamine for example,

optionally in the presence of a coupling agent, such as 2,4,6-tripropyl-1,3,5,2,4,6-trioxatriphosphinane 2,4,6-trioxide (T3P) for example,

thereby providing said compound of formula (VI).

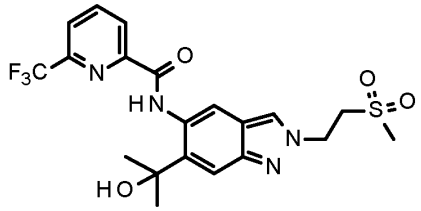
In a further embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I) as described *supra*, wherein said compound of formula (I) is purified by crystallization, particularly from a solvent such as ethanol or isopropanol, for example.

In a variant of said further embodiment of the first aspect, said solvent is ethanol.

In a variant of said further embodiment of the first aspect, said solvent is isopropanol.

In an embodiment of the first aspect, the present invention relates to a method of preparing a compound of formula (I) as described *supra*, wherein said compound of formula (I) is in the form of polymorph B.

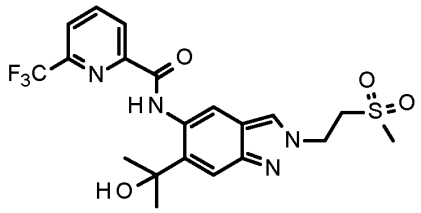
In accordance with a second aspect, the present invention relates to polymorph B of the compound of formula (I):



(I) ,

as prepared by the method as described *supra*.

In accordance with a third aspect, the present invention relates to polymorph B of the compound of formula (I):



(I) .

In accordance with an embodiment of the third aspect, the present invention relates to said polymorph B as described *supra*, having an XRPD peak maxima [°2Θ] (Copper (Cu)) as follows:

Table 2: XRPD of polymorph A, B and 1,7-hydrate of compound (I)

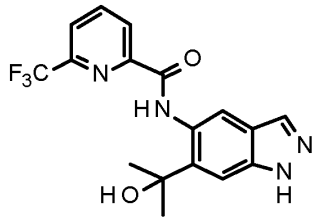
	Reflections [Peak maximum °2Theta]	
Polymorph A	Polymorph B	1/7-Hydrat
4.4	4.4	9.2

8.9	8.9	9.9
9.2	9.3	10.6
9.8	9.7	11.8
10.2	10.1	13.0
10.4	12.4	13.5
11.2	12.9	14.5
12.3	13.3	14.9
12.5	14.1	15.1
12.9	14.7	15.3
13.3	15.4	16.2
13.5	16.1	16.7
14.0	16.4	17.2
14.7	16.7	17.5
15.5	17.3	17.6
15.6	17.9	18.0
16.1	18.3	18.3
16.5	18.4	18.4
17.8	18.5	18.7
18.3	19.2	19.4
18.5	19.4	19.8
19.1	19.7	20.3
19.3	20.2	20.9
19.6	20.6	21.2
19.8	21.2	21.5
20.1	21.4	22.1
20.4	21.9	22.5
20.7	22.3	22.7

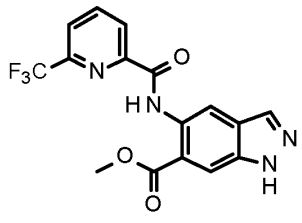
20.9	22.6	22.9
21.2	22.8	23.1
21.6	23.6	23.3
21.7	24.5	23.8
21.8	24.9	23.9
22.2	25.2	24.6
22.6	25.5	25.1
22.8	25.8	25.2
23.1	27.2	25.9
23.2	27.5	26.0
25.0	28.8	26.3
25.7	29.6	26.4
27.2	30.2	26.6
27.6	31.2	27.2
28.3	31.5	27.6
28.9	32.5	27.8
29.0	33.5	28.1
29.4	33.9	28.4
30.0	35.1	29.0
31.2	36.2	29.3
31.5	37.6	29.6
32.5		30.0
32.8		30.2
33.6		30.5
34.0		30.7
36.2		31.0
37.6		31.3

		31.7
		32.0
		32.3
		32.6
		33.2
		33.8
		35.4
		36.0
		36.6
		37.5

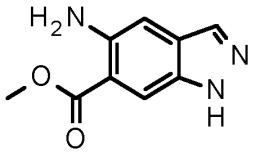
In accordance with a fourth aspect, the present invention relates to use of a compound selected from:



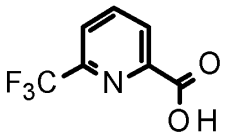
(V) ,



(VI) ,

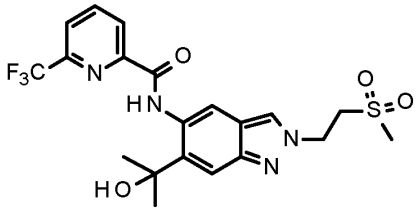


(VIII) ,



(VII) ,

for preparing a compound of formula (I):

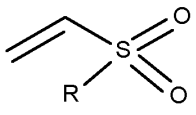


(I) ,

or polymorph B of the compound of formula (I) as described *supra*,

by the method as described *supra*.

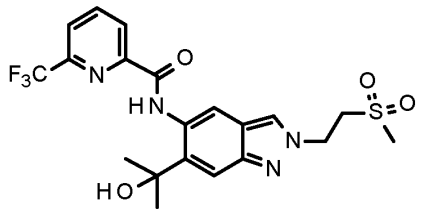
In accordance with a fifth aspect, the present invention relates to use of a vinyl sulphone compound of formula (IX'):



(IX')

in which R represents an alkyl group, such as a methyl, ethyl or n-propyl group for example, or an aryl group, such as a phenyl group for example,

for preparing a compound of formula (I):



(I) ,

or polymorph B of the compound of formula (I) as described *supra*.

In an embodiment of the fifth aspect, the present invention relates to use wherein said vinyl compound of formula (IX') is methyl vinyl sulphone.

In accordance with a sixth aspect, the present invention relates to the use of the crystalline forms of the compound of formula (I), preferably polymorphic form B for manufacturing a medicament.

Method for treatment:

The crystalline forms of the compound of formula (I) according to the invention, preferably polymorphic form B may have useful pharmacological properties and may be employed for the prevention and treatment of disorders in humans and animals. The forms of the compound of formula (I) according to the invention may open up a further treatment alternative and may therefore be an enrichment of pharmacy.

The crystalline forms of the compound of formula (I) according to the invention, preferably polymorphic form B, can be used suitable for treatment and for prevention of proliferative and inflammatory disorders characterized by an overreacting immune system. Particular mention should be made here of the use of the crystalline forms of the compound of formula (I), preferably polymorphic form B according to the invention for treatment and for prevention of neoplastic disorders, dermatological disorders, gynaecological disorders, cardiovascular disorders, pulmonary disorders, ophthalmological disorders, neurological disorders, metabolic disorders, hepatic disorders,

kidney diseases, inflammatory disorders, autoimmune disorders and pain. In particular, the use of the crystalline forms of the compound of formula (I) according to the invention for treatment and for prevention of lymphoma, macular degeneration, psoriasis, lupus erythematosus, multiple sclerosis, COPD (chronic obstructive pulmonary disease), gout, NASH (non-alcoholic steatohepatitits), hepatic fibrosis, insulin resistance, metabolic syndrome, chronic kidney disease, nephropathy, spondyloarthritis and rheumatoid arthritis, endometriosis and endometriosis-related pain and other endometriosis-associated symptoms such as dysmenorrhoea, dyspareunia, dysuria and dyschezia shall be specifically mentioned here.

The crystalline forms of the compound of formula (I) according to the invention, preferably polymorphic form B, can be used suitable for treatment and for prevention of pain as well, including acute, chronic, inflammatory and neuropathic pain, preferably of hyperalgesia, allodynia, pain from arthritis (such as osteoarthritis, rheumatoid arthritis and spondyloarthritis), premenstrual pain, endometriosis-associated pain, post-operative pain, pain from interstitial cystitis, CRPS (complex regional pain syndrome), trigeminal neuralgia, pain from prostatitis, pain caused by spinal cord injuries, inflammation-induced pain, lower back pain, cancer pain, chemotherapy-associated pain, HIV treatment-induced neuropathy, burn-induced pain and chronic pain.

In some embodiments, the present invention further relates to a method for the treatment and/or prophylaxis of diseases, in particular the aforementioned diseases, using an effective amount of at least one of the forms of the compound of formula (I) according to the invention.

In some embodiments, the present invention further relates to a method for the treatment and/or prophylaxis of proliferative and inflammatory disorders characterized by an overreacting immune system, in particular neoplastic disorders, dermatological disorders, gynaecological disorders, cardiovascular disorders, pulmonary disorders, ophthalmological disorders, neurological disorders, metabolic disorders, hepatic disorders, inflammatory disorders, autoimmune disorders and pain using an effective amount of at least one of the forms of the compound of formula (I) according to the invention.

The forms of the compound of formula (I), according to the invention can be used alone or in combination with other active substances if necessary. The present invention further relates to medicinal products containing at least one of the forms of the compound of formula (I) according to the invention and one or more further active substances, in particular for the treatment and/or

prophylaxis of the aforementioned diseases. As suitable, other active substances, the following can be mentioned:

General mention may be made of active ingredients such as antibacterial (e.g. penicillins, vancomycin, ciprofloxacin), antiviral (e.g. aciclovir, oseltamivir) and antimycotic (e.g. naftifin, nystatin) substances and gamma globulins, immunomodulatory and immunosuppressive compounds such as cyclosporin, Methotrexat®, TNF antagonists (e.g. Humira®,, Etanercept, Infliximab), IL-1 inhibitors (e.g. Anakinra, Canakinumab, Rilonacept), phosphodiesterase inhibitors (e.g. Apremilast), Jak/STAT inhibitors (e.g. Tofacitinib, Baricitinib, GLPG0634), leflunomid, cyclophosphamide, rituximab, belimumab, tacrolimus, rapamycin, mycophenolate mofetil, interferons, corticosteroids (e.g. prednisone, prednisolone, methylprednisolone, hydrocortisone, betamethasone), cyclophosphamide, azathioprine and sulfasalazine; paracetamol, non-steroidal anti-inflammatory substances (NSAIDS) (aspirin, ibuprofen, naproxen, etodolac, celecoxib, colchicine).

The following should be mentioned for tumour therapy: immunotherapy (e.g. aldesleukin, alemtuzumab, basiliximab, catumaxomab, celmoleukin, denileukin diftitox, eculizumab, edrecolomab, gemtuzumab, ibritumomab tiuxetan, imiquimod, interferon-alpha, interferon beta, interferon-gamma, ipilimumab, lenalidomide, lenograstim, mifamurtide, ofatumumab, oprelvekin, picibanil, plerixafor, polysaccharide-K, sargramostim, sipuleucel-T, tasonermin, teceleukin, tocilizumab), antiproliferative substances, for example but not exclusively amsacrine, arglabin, arsenic trioxide, asparaginase, bleomycin, busulfan, dactinomycin, docetaxel, epirubicin, peplomycin, trastuzumab, rituximab, obinutuzumab, ofatumumab, tositumomab, aromatase inhibitors (e.g. exemestane, fadrozole, formestane, letrozole, anastrozole, vorozole), antioestrogens (e.g. chlormadinone, fulvestrant, mepitiostane, tamoxifen, toremifen), oestrogens (e.g. oestradiol, polyoestradiol phosphate, raloxifen), gestagens (e.g. medroxyprogesterone, megestrol), topoisomerase I inhibitors (e.g. irinotecan, topotecan), topoisomerase II inhibitors (e.g. amrubicin, daunorubicin, elliptiniumacetate, etoposide, idarubicin, mitoxantrone, teniposide), microtubuli-active substances (e.g. cabazitaxel, eribulin, paclitaxel, vinblastine, vincristine, vindesine, vinorelbine), telomerase inhibitors (e.g. imetelstat), alkylating substances and histone deacetylase inhibitors (e.g. bendamustine, carmustine, chlormethine, dacarbazine, estramustine, ifosfamide, lomustine, mitobronitol, mitolactol, nimustine prednimustine, procarbazine, ranimustine, streptozotocin, temozolomide, thiotepa, treosulfan, trofosfamide, vorinostat, romidepsin, panobinostat); substances which affect cell differentation processes, such as abarelix, aminoglutethimide, bexarotene, MMP inhibitors (peptide mimetics, non-peptide mimetics and tetracyclines, for example marimastat, BAY 12-9566, BMS-275291, clodronate, prinomastat, doxycycline), mTOR inhibitors (e.g. sirolimus, everolimus, temsirolimus, zotarolimus), antimetabolites

(e.g. clofarabine, doxifluridine, methotrexate, 5-fluorouracil, cladribine, cytarabine, fludarabine, mercaptopurine, methotrexate, pemetrexed, raltitrexed, tegafur, tioguanine), platinum compounds (e.g. carboplatin, cisplatin, cisplatinum, eptaplatin, lobaplatin, miriplatin, nedaplatin, oxaliplatin); antiangiogenic compounds (e.g. bevacizumab), antiandrogenic compounds (e.g. bevacizumab, enzalutamide, flutamide, nilutamide, bicalutamide, cyproterone, cyproterone acetate), proteasome inhibitors (e.g. bortezomib, carfilzomib, oprozomib, ONYX0914), gonadoliberin agonists and antagonists (e.g. abarelix, buserelin, deslorelin, ganirelix, goserelin, histrelin, triptorelin, degarelix, leuprorelin), methionine aminopeptidase inhibitors (e.g. bengamide derivatives, TNP-470, PPI-2458), heparanase inhibitors (e.g. SST0001, PI-88); inhibitors against genetically modified Ras protein (e.g. farnesyl transferase inhibitors such as lonafarnib, tipifarnib), HSP90 inhibitors (e.g. geldamycin derivatives such as 17-allylaminogeldanamycin, 17–demethoxygeldanamycin (17AAG), 17-DMAG, retaspimycin hydrochloride, IPI-493, AUY922, BIIB028, STA-9090, KW-2478), kinesin spindle protein inhibitors (e.g. SB715992, SB743921, pentamidine/chlorpromazine), MEK (mitogen-activated protein kinase kinase) inhibitors (e.g. trametinib, BAY 86-9766 (refametinib), AZD6244), kinase inhibitors (e.g.: sorafenib, regorafenib, lapatinib, Sutent®, dasatinib, cetuximab, BMS-908662, GSK2118436, AMG 706, erlotinib, gefitinib, imatinib, nilotinib, pazopanib, roniciclib, sunitinib, vandetanib, vemurafenib), hedgehog signalling inhibitors (e.g. cyclopamine, vismodegib), BTK (Bruton's tyrosine kinase) inhibitor (e.g. ibrutinib), JAK/pan-JAK (janus kinase) inhibitor (e.g. SB-1578, baricitinib, tofacitinib, pacritinib, momelotinib, ruxolitinib, VX-509, AZD-1480, TG-101348), PI3K inhibitor (e.g. BAY 1082439, BAY 80-6946 (copanlisib), ATU-027, SF-1126, DS-7423, GSK-2126458, buparlisib, PF-4691502, BYL-719, XL-147, XL-765, idelalisib), SYK (spleen tyrosine kinase) inhibitors (e.g. fostamatinib, Excellair, PRT-062607), p53 gene therapy, bisphosphonates (e.g. etidronate, clodronate, tiludronate, pamidronate, alendronic acid, ibandronate, risedronate, zoledronate). For combination, the following active ingredients should also be mentioned by way of example but not exclusively: rituximab, cyclophosphamide, doxorubicin, doxorubicin in combination with oestrone, vincristine, chlorambucil, fludarabin, dexamethasone, cladribin, prednisone, 131I-chTNT, abiraterone, aclarubicin, alitretinoin, bisantrene, calcium folinate, calcium levofolinate, capecitabin, carmofur, clodronic acid, romiplostim, crisantaspase, darbepoetin alfa, decitabine, denosumab, dibrospidium chloride, eltrombopag, endostatin, epitiostanol, epoetin alfa, filgrastim, fotemustin, gallium nitrate, gemcitabine, glutoxim, histamine dihydrochloride, hydroxycarbamide, improsulfan, ixabepilone, lanreotide, lentinan, levamisole, lisuride, lonidamine, masoprocol, methyltestosterone, methoxsalen, methyl aminolevulinate, miltefosine, mitoguazone, mitomycin, mitotane, nelarabine, nimotuzumab, nitracrin, omeprazole, palifermin, panitumumab, pegaspargase, PEG epoetin beta (methoxy-PEG epoetin beta), pegfilgrastim, peg interferon alfa-2b, pentazocine, pentostatin, perfosfamide, pirarubicin, plicamycin, poliglusam, porfimer sodium, pralatrexate, quinagolide,

razoxane, sizofirane, sobuzoxan, sodium glycididazole, tamibarotene, the combination of tegafur and gimeracil and oteracil, testosterone, tetrofosmin, thalidomide, thymalfasin, trabectedin, tretinoin, trilostane, tryptophan, ubenimex, vapreotide, yttrium-90 glass microspheres, zinostatin, zinostatin stimalamer.

Also suitable for tumour therapy is a combination of a non-drug therapy such as chemotherapy (e.g. azacitidine, belotecan, enocitabine, melphalan, valrubicin, vinflunin, zorubicin), radiotherapy (e.g. I-125 seeds, palladium-103 seed, radium-223 chloride) or phototherapy (e.g. temoporfin, talaporfin) which is accompanied by a drug treatment with the inventive IRAK4 inhibitors or which, after the non-drug tumour therapy such as chemotherapy, radiotherapy or phototherapy has ended, are supplemented by a drug treatment with the inventive IRAK4 inhibitors.

In addition to those mentioned above, the inventive IRAK4 inhibitors can also be combined with the following active ingredients:

active ingredients for Alzheimer's therapy, for example acetylcholinesterase inhibitors (e.g. donepezil, rivastigmine, galantamine, tacrine), NMDA (N-methyl-D-aspartate) receptor antagonists (e.g. memantine); L-DOPA/carbidopa (L-3,4-dihydroxyphenylalanine), COMT (catechol-O-methyltransferase) inhibitors (e.g. entacapone), dopamine agonists (e.g. ropinirole, pramipexole, bromocriptine), MAO-B (monoaminooxidase-B) inhibitors (e.g. selegiline), anticholinergics (e.g. trihexyphenidyl) and NMDA antagonists (e.g. amantadine) for treatment of Parkinson's; beta-interferon (IFN-beta) (e.g. IFN beta-1b, IFN beta-1a Avonex® and Betaferon®), glatiramer acetate, immunoglobulins, natalizumab, fingolimod and immunosuppressants such as mitoxantrone, azathioprine and cyclophosphamide for treatment of multiple sclerosis; substances for treatment of pulmonary disorders, for example beta-2-sympathomimetics (e.g. salbutamol), anticholinergics (e.g. glycopyrronium), methylxanthines (e.g. theophylline), leukotriene receptor antagonists (e.g. montelukast), PDE-4 (phosphodiesterase type 4) inhibitors (e.g. roflumilast), methotrexate, IgE antibodies, azathioprine and cyclophosphamide, cortisol-containing preparations; substances for treatment of osteoarthritis such as non-steroidal anti-inflammatory substances (NSAIDs). In addition to the two therapies mentioned, methotrexate and biologics for B-cell and T-cell therapy (e.g. rituximab, abatacept) should be mentioned for rheumatoid disorders, for example rheumatoid arthritis, spondyloarthritis and juvenile idiopathic arthritis. Neurotrophic substances such as acetylcholinesterase inhibitors (e.g. donepezil), MAO (monoaminooxidase) inhibitors (e.g. selegiline), interferons und anticonvulsives (e.g. gabapentin); active ingredients for treatment of cardiovascular disorders such as beta-blockers (e.g. metoprolol), ACE inhibitors (e.g. benazepril), angiotensin receptor blockers (e.g. losartan, valsartan), diuretics (e.g. hydrochlorothiazide), calcium channel

blockers (e.g. nifedipine), statins (e.g. simvastatin, fluvastatin); anti-diabetic drugs, for example metformin, glinides (e.g. nateglinide), DPP-4 (dipeptidyl peptidase-4) inhibitors (e.g. linagliptin, saxagliptin, sitagliptin, vildagliptin), SGLT2 (sodium/glucose cotransporter 2) inhibitors/ gliflozin (e.g. dapagliflozin, empagliflozin), incretin mimetics (hormone glucose-dependent insulinotropic peptide (GIP) and glucagon-like peptid 1 (GLP-1) analogues/agonists) (e.g. exenatide, liraglutide, lixisenatide), α-glucosidase inhibitors (e.g. acarbose, miglitol, voglibiose) and sulphonylureas (e.g. glibenclamide, tolbutamide), insulin sensitizers (e.g. pioglitazone) and insulin therapy (e.g. NPH insulin, insulin lispro), substances for treatment of hypoglycaemia, for treatment of diabetes and metabolic syndrome. Lipid-lowering drugs, for example fibrates (e.g. bezafibrate, etofibrate, fenofibrate, gemfibrozil), nicotinic acid derivatives (e.g. nicotinic acid/laropiprant), ezetimib, statins (e.g. simvastatin, fluvastatin), anion exchangers (e.g. colestyramine, colestipol, colesevelam). Active ingredients such as mesalazine, sulfasalazine, azathioprine, 6-mercaptopurine or methotrexate, probiotic bacteria (Mutaflor, VSL#3®, Lactobacillus GG, Lactobacillus plantarum, L. acidophilus, L. casei, Bifidobacterium infantis 35624, Enterococcus fecium SF68, Bifidobacterium longum, Escherichia coli Nissle 1917), antibiotics, for example ciprofloxacin and metronidazole, anti-diarrhoea drugs, for example loperamide, or laxatives (bisacodyl) for treatment of chronic inflammatory bowel diseases. Immunosuppressants such as glucocorticoids and non-steroidale anti-inflammatory substances (NSAIDs), cortisone, chloroquine, cyclosporine, azathioprine, belimumab, rituximab, cyclophosphamide for treatment of lupus erythematosus. By way of example but not exclusively, calcineurin inhibitors (e.g. tacrolimus and ciclosporin), cell division inhibitors (e.g. azathioprine, mycophenolate mofetil, mycophenolic acid, everolimus or sirolimus), rapamycin, basiliximab, daclizumab, anti-CD3 antibodies, anti-T-lymphocyte globulin/anti-lymphocyte globulin for organ transplants. Vitamin D3 analogues, for example calcipotriol, tacalcitol or calcitriol, salicylic acid, urea, ciclosporine, methotrexate, efalizumab for dermatological disorders.

Pharmaceutical compositions:

It is possible for the crystalline forms of the compound of formula (I) to have systemic and/or local activity. For this purpose, they can be administered in a suitable manner, such as, for example, via the oral, parenteral, pulmonary, nasal, sublingual, lingual, buccal, rectal, vaginal, dermal, transdermal, conjunctival, otic route or as an implant or stent.

For these administration routes, it is possible for crystalline forms of the compound of formula (I) to be administered in suitable administration forms.

For oral administration, it is possible to formulate the crystalline forms of the compound of formula (I) to dosage forms known in the art that deliver the compounds of the invention rapidly and/or in a modified manner, such as, for example, tablets (uncoated or coated tablets, for example with enteric or controlled release coatings that dissolve with a delay or are insoluble), orally-disintegrating tablets, films/wafers, films/lyophylisates, capsules (for example hard or soft gelatine capsules), sugar-coated tablets, granules, pellets, powders, emulsions, suspensions, aerosols or solutions. It is possible to incorporate the compounds according to the invention in crystalline and/or amorphised and/or dissolved form into said dosage forms.

Parenteral administration can be effected with avoidance of an absorption step (for example intravenous, intraarterial, intracardial, intraspinal or intralumbal) or with inclusion of absorption (for example intramuscular, subcutaneous, intracutaneous, percutaneous or intraperitoneal). Administration forms which are suitable for parenteral administration are, inter alia, preparations for injection and infusion in the form of solutions, suspensions, emulsions, lyophylisates or sterile powders.

Examples which are suitable for other administration routes are pharmaceutical forms for inhalation [inter alia powder inhalers, nebulizers], nasal drops, nasal solutions, nasal sprays; tablets/films/wafers/capsules for lingual, sublingual or buccal administration; suppositories; eye drops, eye ointments, eye baths, ocular inserts, ear drops, ear sprays, ear powders, ear-rinses, ear tampons; vaginal capsules, aqueous suspensions (lotions, mixturae agitandae), lipophilic suspensions, emulsions, ointments, creams, transdermal therapeutic systems (such as, for example, patches), milk, pastes, foams, dusting powders, implants or stents.

The crystalline forms of the compound of formula (I) can be incorporated into the stated administration forms. This can be effected in a manner known per se by mixing with pharmaceutically suitable excipients. Pharmaceutically suitable excipients include, inter alia,

- fillers and carriers (for example cellulose, microcrystalline cellulose (such as, for example, Avicel®), lactose, mannitol, starch, calcium phosphate (such as, for example, Di-Cafos®)),
- ointment bases (for example petroleum jelly, paraffins, triglycerides, waxes, wool wax, wool wax alcohols, lanolin, hydrophilic ointment, polyethylene glycols),
- bases for suppositories (for example polyethylene glycols, cacao butter, hard fat),
- solvents (for example water, ethanol, isopropanol, glycerol, propylene glycol, medium chain-length triglycerides fatty oils, liquid polyethylene glycols, paraffins),

- surfactants, emulsifiers, dispersants or wetters (for example sodium dodecyl sulfate), lecithin, phospholipids, fatty alcohols (such as, for example, Lanette®), sorbitan fatty acid esters (such as, for example, Span®), polyoxyethylene sorbitan fatty acid esters (such as, for example, Tween®), polyoxyethylene fatty acid glycerides (such as, for example, Cremophor®), polyoxethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, glycerol fatty acid esters, poloxamers (such as, for example, Pluronic®),
- buffers, acids and bases (for example phosphates, carbonates, citric acid, acetic acid, hydrochloric acid, sodium hydroxide solution, ammonium carbonate, trometamol, triethanolamine),
- isotonicity agents (for example glucose, sodium chloride),
- adsorbents (for example highly-disperse silicas),
- viscosity-increasing agents, gel formers, thickeners and/or binders (for example polyvinylpyrrolidone, methylcellulose, hydroxypropylmethylcellulose, hydroxypropyl-cellulose, carboxymethylcellulose-sodium, starch, carbomers, polyacrylic acids (such as, for example, Carbopol®); alginates, gelatine),
- disintegrants (for example modified starch, carboxymethylcellulose-sodium, sodium starch glycolate (such as, for example, Explotab®), cross- linked polyvinylpyrrolidone, croscarmellose-sodium (such as, for example, AcDiSol®)),
- flow regulators, lubricants, glidants and mould release agents (for example magnesium stearate, stearic acid, talc, highly-disperse silicas (such as, for example, Aerosil®)),
- coating materials (for example sugar, shellac) and film formers for films or diffusion membranes which dissolve rapidly or in a modified manner (for example polyvinylpyrrolidones (such as, for example, Kollidon®), polyvinyl alcohol, hydroxypropylmethylcellulose, hydroxypropylcellulose, ethylcellulose, hydroxypropyl-methylcellulose phthalate, cellulose acetate, cellulose acetate phthalate, polyacrylates, polymethacrylates such as, for example, Eudragit®)),
- capsule materials (for example gelatine, hydroxypropylmethylcellulose),
- synthetic polymers (for example polylactides, polyglycolides, polyacrylates, polymethacrylates (such as, for example, Eudragit®), polyvinylpyrrolidones (such as, for example, Kollidon®), polyvinyl alcohols, polyvinyl acetates, polyethylene oxides, polyethylene glycols and their copolymers and blockcopolymers),

- plasticizers (for example polyethylene glycols, propylene glycol, glycerol, triacetine, triacetyl citrate, dibutyl phthalate),
- penetration enhancers,
- stabilisers (for example antioxidants such as, for example, ascorbic acid, ascorbyl palmitate, sodium ascorbate, butylhydroxyanisole, butylhydroxytoluene, propyl gallate),
- preservatives (for example parabens, sorbic acid, thiomersal, benzalkonium chloride, chlorhexidine acetate, sodium benzoate),
- colourants (for example inorganic pigments such as, for example, iron oxides, titanium dioxide),
- flavourings, sweeteners, flavour- and/or odour-masking agents.

The present invention furthermore relates to a pharmaceutical composition, which comprise at least one crystalline form of the compound of formula (I), conventionally together with one or more pharmaceutically suitable excipient(s), and to their use according to the present invention.

Dosage of the pharmaceutical compositions of the present invention:

Based upon laboratory techniques known to evaluate compounds useful for the treatment of disorders, by pharmacological assays for the determination of treatment of the conditions identified above in mammals, and by comparison of these results with the results of known medicaments that are used to treat these conditions, the effective dosage of the compounds of this invention can readily be determined for treatment of each desired indication. The amount of the active ingredient to be administered in the treatment of one of these conditions can vary widely according to such considerations as the particular compound and dosage unit employed, the mode of administration, the period of treatment, the age and sex of the patient treated, and the nature and extent of the condition treated.

The total amount of the active ingredient to be administered will generally range from about 5 to 2000 mg per day, preferably 15 to 750 mg per day, more preferably 15 to 200 mg per day. A unit dosage may contain from about 15 to 750 mg, preferably 15 to 120 mg of active ingredient, and can be administered one or more times per day.

Of course the specific initial and continuing dosage regimen for each patient will vary according to the nature and severity of the condition as determined by the attending diagnostician, the activity of the specific compound employed, the age and general condition of the patient, time of administration, route of administration, rate of excretion of the drug, drug combinations, and the like. The desired mode of treatment and number of doses of a compound of the present invention or a pharmaceutically acceptable salt or ester or composition thereof can be ascertained by those skilled in the art using conventional treatment tests.

The weight data in the tests and examples which follow are, unless stated otherwise, percentages by weight; parts are parts by weight. Solvent ratios, dilution ratios and concentration data of liquid/liquid solutions are based on each case on the volume.

Working Examples

The following examples illustrate the present invention.

Methods:

DSC thermograms were recorded using Differential Scanning Calorimeters (model DSC7, Pyris-1 or Diamond) from Perkin-Elmer. The measurements were performed with a heating rate of 20 $Kmin^{-1}$ [using non-gastight aluminium pans. Flow gas was nitrogen. There was no sample preparation.

TGA thermograms were recorded using thermobalances (model TGA7 and Pyris 1) from Perkin-Elmer. The measurements were performed with a heating rate of 10 $Kmin^{-1}$ using open platinum pans. Flow gas was nitrogen. There was no sample preparation.

X-Ray diffraction patterns were recorded at room temperature using XRD –diffractometers X`Pert PRO (PANalytical) and STOE STADI-P (radiation copper K alpha 1, wavelength 1.5406 Å). There was no sample preparation. All X-Ray reflections are quoted as °2Theta values with a resolution of ± 0.2°.

Raman spectra are recorded at room temperature using FT-Raman-spectrophotometers (model RFS 100 and MultiRam) from Bruker. Resolution is 2 cm^{-1}. Measurements are perfomed in glass vials or aluminium discs. There is no sample preparation.

IR-ATR-spectra are recorded at room temperature using a FT-IR-spectrophotometer one with universal diamond ATR device from Perkin-Elmer. Resolution is 4 cm^{-1}. There is no sample preparation.

HPLC

Method A

Device: Agilent Technologie 1260 Infinity with 1290 Infinity Sampler & Agilent 1100 Series

Zorbax SB-AQ, 50*4,6 mm, 1,5 µm

Buffer: Ammonium dihydrogen phosphate pH: 2.4

Acetonitrile

0 min. 5% buffer

8.3 min 80% buffer

11 min. 80% buffer

210 nm / 4 nm

1.2 ml / min.

Method B

Apparatus	1. Agilent Technologies, HPLC 1290 Infinity (with DAD): Ultra-High performance liquid chromatograph thermostatically controlled column oven, UV-detector and data evaluation system 2. Stainless steel column Length: 5 cm Internal diameter: 2.1 mm Filling: SB-Aq Rapid Resolution HD, 1.8 µm
Reagents	1. Acetonitrile, for the HPLC 2. Tetrahydrofuran, for the HPLC 3. Water, analytical grade 3. Phosphoric acid 85%, analytical grade
Test solution	Dissolve the sample compound of formula (I) in a tetrahydrofuran in a concentration of 0.5 mg/ml. (e. g. dissolve approx. 25 mg sample compound of formula (I), accurately weighed in acetonitrile 50 ml)
Calibration solution	Dissolve the *reference standard compound** in acetonitrile in a concentration of 0.5 mg/ml (e.g.

	dissolve approx. 25 mg reference standard, accurately weighed, in acetonitrile 50 ml). * *reference standard compound* means the compound, which has to be analyzed, as highly pure compound, i.e. >97 area% HPLC
Control solution	Prepare a control solution that is identical with the calibration solution. Additionally, the control solution contains small amounts of the organic impurities.
Detection sensitivity solution	Prepare a solution containing the component Solbrol P (CAS-no.: 94-13-3; propyl 4-hydroxybenzoate) (RT approx. 2.80 min) diluted to a concentration of 0.76 µg/ml.
HPLC conditions	The above described conditions are for example. To achieve optimal separations, they should, if necessary, be adapted to the technical possibilities of the chromatograph and the properties of the respective column.
Eluent	A. water: tetrahydrofuran (v : v) 9 : 1, then add 0.1% phosphoric acid 85% B. Acetonitrile: tetrahydrofuran 9 : 1
Flow rate	0.8 mL/min

Temperature of the column oven	40°C
Temperature of the sample chamber	room temperature
Detection	Measuring wavelength: 220 nm Bandwidth: 6 nm
Injection volume	2.0 µL
Draw Speed	200 µL/min
Needle Wash	Solvent for flush port: tetrahydrofuran
Datenrate	10 Hz
Cell Dimension	10 mm
Equilibration time	10 min (at starting conditions)

Gradient

Time [min]	% A	Gradient
0	95	5
1	85	15
4	80	20
6	40	60
8	20	80
12	20	80

Runtime of the chromatogram	12 min
Calculation of assay (content)	The assay is calculated using linear regression

and taking into account the sample weight, assay, and weight of the reference standard, with a validated chromatographic data system (e.g. Empower).

GC-HS

Residual solvent analysis via headspace gas chromatography (GC-HS)

Agilent 6890 gas chromatograph with split-injection and FID (column: Restek Rxi Sil MS; length: 20 m; internal diameter: 0.18 mm; d_f = 1 µm). Injector temp 160°C, flow 1.2 ml/min (H_2) Split Ratio 18, oven Temp 40°C (4.5min) – 14°C/min – 70°C – 90°C/min – 220°C (1.69 min). Detector: temp 300°C, 400 ml/min (synth air), 40 ml/min (H_2), 30 ml/min (N_2), rate 20 Hz.

Perkin Elmer Turbomatrix 40 headspace sampler: oven 80°C, needle 150°C, transfer line 160°C, system pressure 140 kPa, equilibration time 32 min, pressurization 4.0 min, injection time 0.04 min (Sampler) 0.05 min (GC).

Sample concentration: 20 mg substance in 2 ml DMF

Preparation of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (I)

Example #1

Methyl 5-({[6-(trifluoromethyl)pyridin-2-yl]carbonyl}amino)-1H-indazole-6-carboxylate (VI)

2000 g (10.46 mol) methyl 5-amino-1H-indazole-6-carboxylate, 1899 g (9.94 mol) 6-(trifluoromethyl)pyridine-2-carboxylic acid und 2028 g (15.69 mol) N,N-diisopropylethylamine are mixed in 14.2 kg THF. At 0 to 5°C, 13.3 kg of a solution of T3P in ethyl acetate (50 w%) is added dropwise within 30 min. Stirring is continued for 2 h at the same temperature.

Work-Up:

The reaction mixture is warmed to ambient temperature (20°C). 3000 g of water are added while the temperature is kept at 20 to 25 °C. Stirring is continued for 10 min. The pH is adjusted to ca. 7.4 (7 - 8) using 4 N aq. sodium carbonate solution. Stirring is continued for 10 min. If necessary the pH is again adjusted to 7.4 using 4 N aq. sodium carbonate solution.

The solvents (THF/ethyl acetate) are evaporated under reduced pressure (appr. 200 mbar, 45 - 50°C internal temperature) until the limit of stirring is reached. A mixture of 4.7 kg ethanol and 14.0 kg water is added and the pH is again adjusted to pH 7.4 (7 - 8) using 4 N aq. sodium carbonate solution.

The mixture is stirred for 1 h at 50 °C, subsequently cooled to 20 to 25 °C. Stirring is continued for 10 min at the same temperature. The precipitated crystals are filtered, washed with a mixture of ethanol and water (1.3 kg ethanol with 4 kg water) and dried under vacuum in a drying oven (45°C, N_2 flux, at least 12 h).

According to the above described procedure four batches using 2 kg of starting material (methyl 5-amino-1H-indazole-6-carboxylate) were produced in the technical laboratory:

Yields:

Batch #1: 3476 g (95%)

Batch #2: 3449 g (95%)

Batch #3: 3476 g (95%)

Batch #4: 3494 g (96%)

The purities of all batches were determined to be > 98 area% (HPLC).

HPLC (Method A): Rt = 6.5 min.

MS (ESI pos): m/z = 365 $(M+H)^+$

^{1}H NMR (500 MHz, DMSO-d6): δ [ppm]: 3.98 (s, 3 H), 8.21 (d, 1H), 8.25 (s, 1H), 8.31 (s, 1H), 8.39 (t, 1H), 8.48 (d, 1H), 9.16 (s, 1H), 12.57 (s, 1H), 13.45 (br s, 1H).
^{1}H NMR (300 MHz, DMSO-d6): δ [ppm] = 3.97 (s, 3 H), 8.13 - 8.27 (m, 2 H), 8.30 (s, 1 H), 8.33 - 8.45 (m, 1 H), 8.45 - 8.51 (m, 1 H), 9.15 (s, 1 H), 12.57 (s, 1 H), 13.44 (br s, 1 H).

Example #2

N-[6-(2-hydroxypropan-2-yl)-1H-indazol-5-yl]-6-(trifluoromethyl)pyridine-2-carboxamide (V)

In the following section, different variants of the reaction procedure and work-up are described. These procedures are oriented at the given conditions in the respective technical plants.

The following experiments were performed at the exclusion of water and air using inert gas (N2 or Ar).

Variant #1

50 g (137.255 mmol) of methyl 5-({[6-(trifluoromethyl)pyridin-2-yl]carbonyl}amino)-1H-indazole-6-carboxylate (VI) were dissolved in 800 ml THF. Under normal pressure (1 atm) ca. 300 ml THF were distilled off at 70 °C. The solution was then cooled to 0 to 3°C.

The solution was kept at this temperature and added dropwise within 120 min to a cooled mixture of 457.5 ml (1372.6 mmol) methylmagnesium chloride 3 M in THF and 29.1 g lithium chloride (686.3 mmol) at 0 to 3°C. After the addition was completed, a sample was taken out of the mixture and subjected to HPLC analysis showing that conversion was completely done. The mixture was poured carefully over 25 min at 0 to 3°C into 500 ml ½-sat. aq. sodium chloride solution (attention: exothermic! During the first 50 ml a strong rise in temperature to 29 °C was observed!). A suspension was received which dissolved when 358 ml 20 w% aq. citric acid were added (pH dropped from 8.08 to 4.28). Stirring was continued for 10 min at 20 to 25°C. 500 ml of ethyl acetate were added and stirring was continued for 10 min. The phases were separated. The mulm was added to the organic phase. 5 g of activated charcoal were added to the organic phase. The mixture was heated to 78°C (internal temperature), stirred for 30 min at that temperature

and subsequently cooled to 50°C (internal temperature). The warm solution was filtered over celite and washed twice with 125 ml ethyl acetate. The mixture was concentrated to ca. 150 ml at ambient pressure (1 atm) and 110°C. 350 ml of toluene were added and 200 ml were distilled off at ambient pressure (1 atm) and 110°C. The product precipitated. At 60°C internal temperature, 200 ml n-heptane were added over 45 min. The mixture was cooled to 0 to 3°C and stirred for 2 h at this temperature. The product was filtered and washed twice with a mixture of 50 ml toluene/n-heptane (1 : 1). The precipitated product was dried in a drying oven at 40°C and 20 mbar for > 48 h.

Yield: 39.42 g (78.83%, purity 97.84 area% HPLC)

HPLC (Method A): Rt = 5.8 min.

MS (ESIpos): m/z = 365 $(M+H)^+$

^{1}H-NMR (400MHz, DMSO-d6): δ [ppm]= 1.63 (s, 6H), 5.99 (s, 1H), 7.50 (s, 1H), 8.06 (s, 1H), 8.17 (d, 1H), 8.37 (t, 1H), 8.46 (d, 1H), 8.78 (s, 1H), 12.33 (s, 1H), 12.97 (br s, 1H).

13 batches were produced following the procedure of variant #1. The table 3 below summarizes the respective yields. The reactions were performed at 1 kg scale with regard to the use of methyl 5-({[6-(trifluoromethyl)pyridin-2-yl]carbonyl}amino)-1H-indazole-6-carboxylate (VI) as starting material. In most cases, two of batches were united after treatment with activated charcoal:

Table 3: Yields obtained for batches 1 to 13 of synthesis of (V) from (VI)

Batch #	Yield [kg] [%]
1	1.60 kg
2	79.9 %
3	1,88 kg
4	94.0 %
5	1,82 kg
6	90.8 %
7	1,66 kg
8	83.0 %
9	1,75 kg
10	87.6 %
11	1,85 kg

12	92.7 %
13*	0,92 kg 96.4 %

*) single batch

Variant #2

30 g (82.4 mmol) methyl 5-({[6-(trifluoromethyl)pyridin-2-yl]carbonyl}amino)-1H-indazole-6-carboxylate (VI) were dissolved in 480 ml THF. Under normal pressure (1 atm) ca. 180 ml THF were distilled off at 70°C. The mixture (slight suspension) was then cooled to 0 to 3°C.

The solution was kept at this temperature and added dropwise within 120 min to a cooled mixture of 274.5 ml (823.5 mmol) methylmagnesium chloride 3 M in THF and 17.5 g lithium chloride (411.8 mmol) at 0 to 3°C. 15 min after the addition was completed, a sample was taken out of the mixture and subjected to HPLC analysis showing that (VI) was completely converted. The mixture was poured carefully over 15 min at 0 to 3°C into 300 ml of water (attention: exothermic! During the first 50 ml a strong rise in temperature was observed!). 310 ml 20 w% aq. citric acid were added (pH dropped to 4.05). Stirring was continued for 60 min at 20 to 25°C. 300 ml of ethyl acetate were added and stirring was continued for 30 min. The phases were separated. The mulm was added to the organic phase. The organic phase was washed twice with 450 ml of water. The organic phase was concentrated to 350 ml at 65 °C (internal temperature) and ambient pressure (1 atm). 250 ml ethyl acetate were added. 6 g of activated charcoal were added to the organic phase. The mixture was heated to 65 °C (internal temperature), stirred for 120 min at that temperature and subsequently cooled to 50 °C (internal temperature). The warm solution was filtered over celite and washed twice with 125 ml ethyl acetate. The mixture was concentrated to ca. 150 ml at ambient pressure (1 atm) and 110 °C. 300 ml of toluene were added and 200 ml were distilled off at ambient pressure (1 atm) and 110 °C. The product precipitated. At 60 °C internal temperature, 200 ml n-heptane were added over 45 min. The mixture was cooled to 0 - 3 °C and stirred for 2 h at this temperature. The product was filtered and washed twice with a mixture of 50 ml toluene/n-heptane (1:1). The precipitated product was dried in a drying oven at 40 °C and 20 mbar for >48 h.

Yield: 24.0 g (80%, purity: 95.8 area% HPLC)

HPLC (Method A): Rt = 5.8 min.

MS (ESI pos): m/z = 365 $(M+H)^+$

^{1}H-NMR (400MHz, DMSO-d6): δ [ppm]= 1.63 (s, 6H), 5.99 (s, 1H), 7.50 (s, 1H), 8.06 (s, 1H), 8.17 (d, 1H), 8.37 (t, 1H), 8.46 (d, 1H), 8.78 (s, 1H), 12.33 (s, 1H), 12.97 (br s, 1H).

Variant #3

30 g (82.4 mmol) methyl 5-({[6-(trifluoromethyl)pyridin-2-yl]carbonyl}amino)-1H-indazole-6-carboxylate (VI) were dissolved in 600 ml THF. Under normal pressure (1 atm) ca. 150 ml THF were distilled off at 70 °C. The mixture (slight suspension) was then cooled to 0 - 3 °C.

The solution was kept at this temperature and added dropwise within 120 min to a cooled mixture of 274.5 ml (823.5 mmol) methylmagnesium chloride 3 M in THF and 17.5 g (411.8 mmol) lithium chloride at 0 - 3 °C. The dropping funnel was rinsed twice with 10 ml THF. 15 min after the addition was complete, a sample was taken out of the mixture and subjected to HPLC analysis showing that (VI) was completely converted. The mixture was poured carefully over 10 min at 0 - 3 °C into 300 ml of water (attention: exothermic! During the first 50 ml a strong rise in temperature to 25 °C was observed!). 250 ml 20 w% aq. citric acid were added (pH dropped from 8 to 4). Stirring was continued for 30 min at 20 - 25 °C. 300 ml of ethyl acetate were added and stirring was continued for 10 min. The phases were separated. The mulm was added to the organic phase. The organic phase was washed twice with 200 ml of 1 w% sodium chloride aq. solution. The phases were separated. The organic phase was concentrated to 250 ml at 65 °C (internal temperature) and ambient pressure (1 atm). 150 ml ethyl acetate and 6 g of activated charcoal were added to the organic phase. The mixture was heated to 65 °C (internal temperature), stirred for 120 min at that temperature and subsequently cooled to 50 °C (internal temperature). The warm solution was filtered over celite and washed twice with 50 ml ethyl acetate. The mixture was concentrated to ca. 100 ml at ambient pressure (1 atm) and 110 °C. 300 ml of isopropanol were added. 300 ml were distilled off at ambient pressure (1 atm) and 110 °C. 300 ml isopropanol were added again and distilled off (ca. 355 ml) at 110 °C. The resulting suspension was cooled to 20-25 °C. 45 ml water were added over 45 min. The mixture was stirred for 1 h. The precipitated product was filtered and washed with 50 ml of a water/isopropanol (1:1) mixture. The precipitated product was dried in a drying oven at 50 °C and 20 mbar for >48 h.

Yield: 24.9 g (83 %, purity: 97.84 area% HPLC)

HPLC (Method A): Rt = 5.8 min.

MS (ESI pos): m/z = 365 $(M+H)^+$

^{1}H-NMR (400MHz, DMSO-d6): δ [ppm]= 1.63 (s, 6H), 5.99 (s, 1H), 7.50 (s, 1H), 8.06 (s, 1H), 8.17 (d, 1H), 8.37 (t, 1H), 8.46 (d, 1H), 8.78 (s, 1H), 12.33 (s, 1H), 12.97 (br s, 1H).

Variant #4

This variant was used for the production of technical batches at kg scale (>10 kg) (see table 4).

60 g (164.7 mmol) methyl 5-({[6-(trifluoromethyl)pyridin-2-yl]carbonyl}amino)-1H-indazole-6-carboxylate (VI) were dissolved in 1500 ml THF. Under normal pressure (1 atm) ca. 600 ml THF were distilled off at 70 °C. The mixture (yellow solution) was then cooled to 0 - 3 °C.

The solution was kept at this temperature and added dropwise within 120 min to a cooled mixture of 550 ml (1647.1 mmol) methylmagnesium chloride 3 M in THF and 35 g (823.5 mmol) lithium chloride at 0 - 3 °C. 15 min after the addition was complete, a sample was taken out of the mixture and subjected to HPLC analysis showing that (VI) was completely converted. The mixture was poured carefully over 15 min at 0 - 3 °C into 600 ml of water (attention: exothermic! During the first 50 ml a strong rise in temperature was observed!). 600 ml 20 w% aq. citric acid were added (pH dropped to 4). Stirring was continued for 30 min at 20 - 25 °C. The phases were separated. The organic phase was washed twice with 400 ml of 1 w% sodium chloride aq. solution. The mulm was added to the organic phase. The phases were separated. The organic phase was concentrated to 700 ml at 65 °C (internal temperature) and ambient pressure (1 atm). 500 ml ethyl acetate and 12 g of activated charcoal were added to the organic phase. The mixture was heated to 65 °C (internal temperature), stirred for 120 min at that temperature and subsequently cooled to 50 °C (internal temperature). The warm solution was filtered over celite and washed twice with 200 ml ethyl acetate. Concentration was continued under reduced pressure (200 mbar). A solvent swap to toluene was performed (remaining volume ca. 850 mL). The resulting suspension was cooled to 0 - 3 °C. The precipitated product was filtered and washed with 50 ml of toluene. The precipitated product was dried in a drying oven at 50 °C and 20 mbar for >48 h.

Yield: 51.2 g (85.3 %, purity 96.51 area% HPLC)

HPLC (Method A): Rt = 5.8 min.

MS (ESI pos): m/z = 365 $(M+H)^+$

^{1}H-NMR (400MHz, DMSO-d6): δ [ppm]= 1.63 (s, 6H), 5.99 (s, 1H), 7.50 (s, 1H), 8.06 (s, 1H), 8.17 (d, 1H), 8.37 (t, 1H), 8.46 (d, 1H), 8.78 (s, 1H), 12.33 (s, 1H), 12.97 (br s, 1H).

Variant #5

Purification via stirring in isopropanol/water

Depending on the purity of the crude product, an additional purification step via stirring in mixtures of isopropanol and water, preferably 1:1, can be performed. Depending on the purity of the crude product, stirring is performed in a range of 2 - 10 volumes with regard to the crude starting material. The following example describes stirring in 3 volumes isopropanol/water:

7,5 g N-[6-(2-hydroxypropan-2-yl)-1H-indazol-5-yl]-6-(trifluoromethyl)pyridine-2-carboxamide (V) with a purity of 95 area% (HPLC) are stirred in 22.5 ml of a 1:1 (vol) mixture of water and isopropanol for 2 h at 20 °C. The suspension was then filtered and the product washed with 4 ml of the same solvent mixture. The product was dried in drying oven at 50 °C under vacuum (<100 mbar).

Yield: 6.8 g (90.7 %, purity > 98 area% HPLC)

HPLC (Method A): Rt = 5.8 min.

MS (ESIpos): m/z = 365 $(M+H)^+$

^{1}H-NMR (400MHz, DMSO-4): δ [ppm]= 1.63 (s, 6H), 5.99 (s, 1H), 7.50 (s, 1H), 8.06 (s, 1H), 8.17 (d, 1H), 8.37 (t, 1H), 8.46 (d, 1H), 8.78 (s, 1H), 12.33 (s, 1H), 12.97 (br s, 1H).

A combination of variant #4 and #5 was performed at 44 kg scale (see table 4 below).

Table 4: Manufacturing of compound according to formula (V) following the protocols of variant #4 and #5

Batch #	Yield	Content (Assay for use)
1	38.4 kg 79 %	95.9 %
2	33.6 kg 76 %	96.0 %

Example #3

N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (I)

Variant #1

This variant was used for the production of technical batches at kg scale and follows the protocol described in WO2016/083433.

2.5 kg (6.86 mol) N-[6-(2-hydroxypropan-2-yl)-1H-indazol-5-yl]-6-(trifluoromethyl)pyridine-2-carboxamide (V) were suspended in 33 l (28.6 kg) toluene. The mixture was heated to reflux and app. 8 l toluene were distilled off the mixture. The mixture was cooled to 90 °C and 44 g (0.34 mol) of N,N-diisopropylethylamine were dosed to the mixture. The mixture was stirred for further 15 min at 90 °C before 1.17 kg (10.98 mmol) methyl vinyl sulfone were added. The reaction mixture was kept at 112 °C (reflux toluene) and stirred for at least 72 h. The mixture was cooled to 20 °C. The mixture was then heated to reflux and 8 l of toluene were distilled off the mixture. The mixture was then cooled to 70 °C and 12.6 kg methyl *tert*-butyl ether (MTBE) were added within 30 min. The mixture was cooled to 20 °C within 2 h and stirred at 20 °C overnight. It was then cooled to 0 °C and stirred for 1 h. The precipitate was filtered off and washed twice with 3 l of cold MTBE. The crystalline product was dried in an oven at 50 °C under vacuum.

Yield: 2.39 kg (73.9 %, purity: 97.8 area% HPLC)

HPLC (Method B): Rt = 3.07 min.

MS (ESI pos): m/z = 471 $(M+H)^+$

^{1}H NMR (400 MHz, DMSO-d_6): δ [ppm]= 1.63 (s, 6 H), 2.90 (s, 3 H), 3.85 (t, 2 H), 4.86 (t, 2 H), 5.97 (s, 1 H), 7.59 (s, 1 H), 8.13 - 8.19 (m, 1 H), 8.37 (s, 1 H), 8.41 - 8.48 (m, 2 H), 8.74 (s, 1 H), 12.37 (s, 1 H).

Table 5: Yields and purity (in % after HPLC) obtained for three batches of (I) from (V)

Starting Material (V) Amount [kg]	Product (I) Yield [kg], [%]	Product (I) Purity [area%] (HPLC)*
2.50	2.47, 76.5	97.4
2.50	2.32, 71.4	97.2
2.50	2.39, 73.9 (described)	97.8 (described)

* Method B

For obtaining material with very high purity and with a defined crystalline form (polymorph B), an additional purification step was introduced.

1.85 kg of crude N-{6-(2-hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (I) were dissolved in 36.6 kg (46.3 l) of acetone at ambient temperature. The resulting solution was dosed into refluxing ethanol during 2.5 h. During the dosing process 54 l of solvent were distilled off and an internal temperature of 63 °C was reached. Additional 20.8 l ethanol were added and 27 l of solvents were distilled off the mixture. Additionally, 10.2 l additional ethanol were added and 9.3 l were distilled off the mixture. Finally, another 10.2 l additional ethanol were added and 10.2 l of solvents were distilled off the mixture. The mixture was cooled to 20 °C within 3 h and stirred overnight. The mixture was cooled to 0-2 °C within 1.5 h and stirred at this temperature for additional 3 h. The suspension was filtered and the precipitate was washed with 2x 0.93 l cold ethanol. The product was dried in a drying oven at 50 °C under vacuum.

Yield: 1.59 kg (85.7 %, purity: 99.0 area% HPLC)

HPLC (Method B): Rt = 3.07 min.

MS (ESI pos): m/z = 471 $(M+H)^+$

^{1}H NMR (400 MHz, DMSO-d_6): δ [ppm]= 1.63 (s, 6 H), 2.90 (s, 3 H), 3.85 (t, 2 H), 4.86 (t, 2 H), 5.97 (s, 1 H), 7.59 (s, 1 H), 8.16 (d, 1 H), 8.37 (t, 1 H), 8.41 - 8.48 (m, 2 H), 8.74 (s, 1 H), 12.37 (s, 1 H).

Table 6: Yield and purity obtained from synthesis as well as purity (%) after HPLC for (I) synthesized from (V)

Starting Material: Crude (I) Amount [kg], Purity [area%] (HPLC)	Product (I) Yield [kg], [%]	Product (I) Purity [area%] (HPLC)*
1.85, 97.4	1.56, 84.2	98.9
1.85, 97.2	1.59, 86.1	99.1
1.85, 97.8	1.59, 85.7 (described)	99.0 (described)

Variant #2

This variant was used for the production of technical batches at kg scale.

10 g (27.448 mmol) N-[6-(2-hydroxypropan-2-yl)-1H-indazol-5-yl]-6-(trifluoromethyl)pyridine-2-carboxamide (V) were suspended in 100 ml toluene. 3.496 g (32.937 mmol) methyl vinyl sulfone were added. The reaction mixture was heated to 110 °C (reflux toluene) and stirred for at least 15 h. An additional portion of 583 mg (5.49 mmol) methyl vinyl sulfone was added and the reaction mixture stirred for 7 h at reflux. Further 583 mg (5.49 mmol) methyl vinyl sulfone were added and the reaction mixture stirred for >15 h. According to HPLC analysis, 2.5% of starting material (V) were still in the reaction mixture. The selectivity N1/N2 had amounted to 1:8. 30 ml

of toluene were distilled off. The mixture was cooled to 70 °C. At this temperature, 70 ml MTBE were dropped within 5 min to the mixture resulting in a suspension. The mixture was cooled to 20 °C overnight. It was then cooled to 0 °C and stirred for 2 h. The precipitate was filtered off and washed twice with 10 ml of cold MTBE. The crystalline product was dried in drying oven for at least 48 h at 50 °C and <100 mbar.

Yield: 8.6 g (66.6 %, purity: 94.7 area% HPLC)

HPLC (Method B): Rt = 3.07 min.

MS (ESI pos): m/z = 471 $(M+H)^+$

^{1}H NMR (400 MHz, DMSO-d_6): δ [ppm]= 1.63 (s, 6 H), 2.90 (s, 3 H), 3.85 (t, 2 H), 4.86 (t, 2 H), 5.97 (s, 1 H), 7.59 (s, 1 H), 8.16 (d, 1 H), 8.37 (t, 1 H), 8.41 - 8.48 (m, 2 H), 8.74 (s, 1 H), 12.37 (s, 1 H).

Batches at technical scale:

Following the procedure described as variant #2 batches at scales of 3.396 kg and 1.699 kg with regard to starting material (V) were produced:

Table 7: Yield for compound (I) synthesized from compound (V)

Starting Material (V) Amount	Product (I) Yield
3.40 kg	2.81 kg, 64.1 %
1.70 kg	1.28 kg, 58.2 %

Preparation of polymorphic forms of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (I)

Preparation of polymorphic form B of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)-ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (I)

When the term "room temperature" is used in the following synthesis protocols, a temperature of about 20 to 25 °C is meant.

Example 0

For the production of cGMP-grade material and for adjusting the crystalline form for tablet production, an additional purification step was introduced.

1500 kg of crude N-{6-(2-hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (I) were dissolved in 45 kg of acetone and subjected to clarification filtration (filter cartridge: 3.0 µm → GMP-filtration). The filtrate was concentrated and a solvent swap to ethanol was performed. Thereby, ethanol was added during simultaneous distillation until an internal temperature of 77 °C was reached. The solution was concentrated to 6-7 volumes of ethanol with regard to the starting volume. The mixture was cooled to 20 °C and stirred for 12 h at this temperature. It was then cooled to 0 °C and stirred for additional 3 h. The product was filtered off, and washed twice with 1 kg cold ethanol. The product was dried in a drying oven at 60 °C under vacuum (<100 mbar).

Yield: 1370 g (91.33 %). Analogous to the described procedure, three batches were carried out at technical scale, see table 7.

Table 8: Yield of pure compound (I) obtained by purification described *supra* from crude (I)

Starting Material (crude I) [kg]	Product (pure I) Yield [kg], [%]
1.50	1.37 (91.3 %)
2.04	1.78 (87.5 %)
2.03	1.86 (91.4 %)

Table 9: Analytical data of combined three batches as shown in table 8

Purity (HPLC)*	≥ 99% (area)
Content (assay for use)	≥ 97.7% (weight)
Ethanol	< 0.25 % (weight)**
Pd	< 1 ppm

* Method B; ** GC-HS

Example 1

Preparation of polymorphic form A of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide

A) 400 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were dissolved in 40 mL THF under reflux. The solution was filtered. Evaporation of the clear solution to dryness was done by storage at room temperature or in the refrigerator or in freezer.

B) 400 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were dissolved in 40 mL acetone under reflux. The solution was filtered. Evaporation of the clear solution to dryness was done by storage at room temperature or in the refrigerator.

C) 400 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were dissolved in 40 mL acetone under reflux. 20 mL of water were added to the solution. Evaporation of the clear solution to dryness was done by storage at room temperature.

Example 2

Preparation of polymorphic form B of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide

A) 400 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were dissolved in 40 mL acetonitrile under reflux. The solution was filtered and the clear solution was evaporated to dryness by storage at room temperature.

B) 400 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were dissolved in 40 mL acetone under reflux. The solution was filtered and the clear solution was evaporated to dryness by storage in a freezer.

C) 400 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were dissolved in 40 mL tetrahydrofuran under reflux. 20 mL of n-heptane were added to the solution and afterwards it was evaporated to dryness by storage at room temperature.

Example 3

Preparation of pseudopolymorphic form (1,7 Hydrate) of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide

100 mg of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were suspended in 1 mL of a 1 : 1 mixture of ethanol/water and stirred for two weeks at room temperature. The solid was filtered off and dried by storage at room temperature.

XRPD data of polymorph A, B and 1,7-hydrate of compound (I) are given in table 2 and in Figure 1, 2 and 3.

X-ray powder diffraction; measurement conditions:

Anode material Cu

K-Alpha1 [Å]	1,54060
Generator settings	40 mA, 40 kV
Primary beam monochromator	focusing X-ray mirror
Sample spinning	yes
Scan axis	Gonio
Start Position [°2Th.]	2.0066
End Position [°2Th.]	37.9906

Example 4

Pharmaceutical composition containing one of the polymorphic forms A or B or the pseudopolymorphic form (1,7-hydrate) of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)-ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide

The granulation liquid is prepared by mixing the micronized form of compound of formula (I), sodium laurilsulfate, hypromellose 3 cP, and purified water in bulk. Mannitol, cellulose microcrystalline, and croscarmellose sodium are mixed. This blend is granulated with the granulation liquid in the fluidized bed granulator. The granules are dried and sieved.

The granules are mixed with sieved magnesium stearate in a blender resulting in the ready-to-press mixture. The ready-to-press mixture is compressed into tablets. The uncoated tablets are tested for uniformity of mass, thickness, resistance to crushing, disintegration, and friability. Hypromellose 5 cP, macrogol 3350, talc, titanium dioxide, and ferric oxide red are combined with purified water in bulk to result in a homogeneous coating suspension, which is sprayed onto the tablets in a suitable coating device, e.g. perforated drum coater.

Table 10: Composition of tablets

Composition	Amount [mg]
Drug substance	
polymorphic form B of compound of formula (I)	15.00
Excipients	
Mannitol	25.30
Cellulose microcrystalline	41.00
Croscarmellose sodium	4.50
Hypromellose 3 cP	3.00
Sodium laurilsulfate	0.50
Magnesium stearate	0.70
Weight (uncoated tablet)	**90.00**
Film-coating	
Hypromellose 5 cP (syn.: Hydroxypropylmethylcellulose 2910)	1.75
Macrogol 3350 (syn.: Polyethylene glycol (3350))	0.35
Talc	0.35
Titanium dioxide [a]	0.98
Ferric oxide red [a]	0.07
Weight (film-coating)	**3.50**
Weight (coated tablet)	**93.50**

Tablets each containing 15 and 120 mg of the polymorphic form B of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)¬ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide were prepared following the protocol given in example 4.

Assay for stability of a pharmaceutical composition containing one of the polymorphic forms A or B or the pseudopolymorphic form (1,7-hydrate) of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)¬ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide

Coated tablet containing 15 mg or 120 mg of the polymorphic form B of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)¬ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (drug substance) are packaged in HDPE (**H**igh-**D**ensity **P**oly**e**thylene) bottles with child resistant white

polypropylene/ polyethylene screw cap closures. This packaging configuration provides sufficient protection from light and humidity.

Stability studies are conducted with testing of the stability indicating parameters appearance, dissolution, degradation products, and content of drug substance at regular intervals to confirm the stability of coated tablet containing 15 mg or 120 mg of the drug substance over the proposed study duration.

The samples of coated tablets (15 mg or 120 mg) packaged in HDPE bottles are stored at 25 °C / 60% relative humidity, 30 °C / 75% relative humidity and 40 °C / 75% relative humidity, as well as at 2 – 8 °C. The experiments for stability investigation are regularly performed.

Coated tablets containing either 15 mg or 120 mg of the polymorphic form B of N-{6-(2-Hydroxypropan-2-yl)-2-[2-(methylsulphonyl)¬ethyl]-2H-indazol-5-yl}-6-(trifluoromethyl)pyridine-2-carboxamide (drug substance) are stable under all investigated conditions. During this storage period no increase of degradation products and no decrease of the content of the drug substance were observed.