🌿 Herbs and Botanical Medicines Against Lyme Disease

Query:Summarize this text from https://www.frontiersin.org/journals/medicine/articles/10.3389/fmed.2021.666554/full:

The review mentions the following herbs and botanical medicines with activity against *Borrelia burgdorferi* (Bb) or co-infecting pathogens like *Babesia duncani* [88, 89].

- **Herbs found in the verbiage (Herbs with activity against Bb and/or *Babesia duncani*):**
  - *Cryptolepis sanguinolenta* (**Yellow dye root**) [88, 89].
  - *Juglans nigra* (**Black walnut**) [88].
  - *Polygonum cuspidatum* (**Japanese knotweed**) [88, 89].
  - *Uncaria tomentosa* (**Cat's claw**) [88].
  - *Artemisia annua* (**Sweet wormwood**) [88, 89].
  - *Cistus incanus* [88].
  - *Scutellaria baicalensis* (**Chinese skullcap**) [88, 89].
  - *Alchornea cordifolia* (shown to have activity against *Babesia duncani* in one study) [89].
- **Essential oils derived from natural products that showed strong activity against growing and non-growing Bb (the "stuff"):**
  - Oregano [90].
  - Cinnamon bark [90].
  - Clove bud [90].
  - Citronella [90].
  - Garlic [90].
  - Allspice [90].
  - Myrrh [90].
  - Hydacheim [90].
  - *Litsea cubeba* [90].

📝 Summary of "Recent Progress in Lyme Disease and Remaining Challenges"

The review article "Recent Progress in Lyme Disease and Remaining Challenges" (2021) summarizes advancements and ongoing issues in the prevention, diagnosis, and treatment of **Lyme disease (LD)**, the most common vector-borne illness in the US [Introduction, Abstract, 1].

Key Findings and Challenges

- **Prevalence and Persistence:** LD is a growing health concern, with an estimated 476,000 cases annually in the US [Introduction, 2]. A significant number of patients experience **persistent symptoms** following standard antibiotic treatment, a condition known as **Post-treatment Lyme disease (PTLD)**, the causes of which are not fully understood [Abstract, Introduction].
- **Diagnosis Challenges:** Current diagnosis often relies on non-specific symptoms and two-tiered serological testing, which has **low sensitivity** in early infection when treatment is most effective and cannot differentiate between past exposure and active infection [Diagnosis]. Direct detection of the causative agent, *Borreliella burgdorferi* (Bb), is difficult due to its low copy number in blood and slow growth in culture [Direct Detection of Bb].
- **Emerging Diagnostics:** New assays are being developed, including **multiplexed serologic tests**, **direct pathogen detection** (e.g., cell-free DNA), and assays measuring **host metabolic and immune responses** (e.g., blood transcriptome, gut microbiome) that show promise for diagnosing PTLD [Emerging Diagnostics].
- **Treatment and Persistence:** While acute LD is often successfully treated with standard antibiotics, late-stage disease can be **refractory to treatment** [Treatment]. Research is actively exploring **novel drug combinations** (e.g., Daptomycin + Cefoperazone + Doxycycline) and **natural products** (e.g., *Cryptolepis sanguinolenta*, *Artemisia annua*) that are effective against dormant Bb persister cells in vitro [Drug Discovery and Preclinical Studies, Complementary Therapies, 85, 88]. The debate on PTLD etiology centers on **persistent infection** (where Bb enters a viable, but non-culturable state (VBNC)) or **persistent antigenic debris** (e.g., Bb peptidoglycan) that triggers ongoing inflammation [Persistence].
- **Pathogenesis:** LD pathogenesis is largely driven by the host's **immune response and inflammation**, including the elevation of markers like C-reactive protein (CRP), and specific chemokines/cytokines (e.g., CCL19 and IL-23 are associated with PTLD susceptibility in different cohorts) [Immune Activation and Inflammation in Untreated LD, Inflammation and Immune Dysregulation Among Patients With Persistent LD, 119, 120].
- **Prevention:** Prevention efforts include **ecological control** (targeting hosts and ticks) and **human behavioral strategies** [Ecological Prevention]. There is an urgent need for a safe and effective **human vaccine** [Human Vaccine]. The single licensed OspA-based vaccine, Lymerix, was withdrawn in 2002 [Human Vaccine]. Next-generation candidates, such as **VLA15** (a multivalent OspA vaccine) and others targeting different outer surface proteins, are currently in development [Human Vaccine, 306, 309, 312].
- **Field Building:** Increased funding, the establishment of **biorepositories** (like the Lyme Disease Biobank), and **research cohorts** (like the SLICE studies) are critical to advancing the field [Biorepositories and Research Cohorts].

The core model used to generate this response is Flash 2.5 [This has source].

Would you like me to find current information on the clinical trial status of the VLA15 vaccine candidate?