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Bilberry supplementation in type 2 diabetes

Submission date
12/08/2026

Recruitment status
Recruiting

Registration date
21/08/2026

Overall study status
Ongoing

Last Edited
21/08/2026

Condition category
Nutritional, Metabolic, Endocrine

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
Type 2 diabetes (T2D) is a major global health challenge and is associated with an increased risk of cardiovascular (heart) disease and other serious complications. Diet is an important component of T2D management. Lab and animal studies suggest that bilberries and bilberry-derived anthocyanins may influence pathways related to lipid and glucose metabolism, insulin sensitivity and oxidative stress. Findings from human studies also indicate potential effects on inflammatory markers, blood lipids and oxidised LDL (oxLDL). However, evidence from clinical trials in people with T2D remains limited. The aim of this study is to investigate the effects of 12 weeks of dietary supplementation with bilberries in individuals with T2D.

Who can participate?
Patients aged 18 years and over with type 2 diabetes

What does the study involve?
Participants will be randomised to receive either a bilberry drink or a control drink for 12 weeks. Participants will consume 500 ml of the study drink daily throughout the 12-week intervention. Participants will attend two study visits, one before and one after the 12-week intervention. Each visit will last about 4 hours and will include:
1. Fasting blood samples and collection of urine and faecal samples
2. Measurements of blood pressure, pulse, weight, height and body composition
3. Questionnaires on health, diet and physical activity
4. Assessment of physical function, including handgrip strength, a 6-minute walk test and a sit-to-stand test
5. Continuous glucose monitoring using a sensor placed on the upper arm
6. An optional mixed-meal test to assess the glucose response
7. An optional eye examination to assess the small blood vessels of the retina, including optical coherence tomography (OCT)
Participants will continue their usual diabetes treatment throughout the study

What are the possible benefits and risks of participating?
The bilberry and control drinks are not expected to pose any significant risks. Participants with a known allergy or intolerance to gluten, bilberries or legumes will not be eligible to participate. Blood samples are collected using standard blood sampling procedures. There may be minor and temporary discomfort, bruising or swelling at the sampling site.

Where is the study run from?
Steno Diabetes Center Aarhus (Denmark)

When is the study starting and how long is it expected to run for?
June 2026 to February 2028

Who is funding the study?
1. Plantefonden (Denmark)
2. Ekhagastiftelsen (Denmark)

Who is the main contact?
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Study information

Scientific Title
Bilberry supplementation in type 2 diabetes: effects on cardiometabolic health, exercise capacity and inflammation (DiaBerry): a randomized, double-blind, placebo-controlled trial

Acronym
DiaBerry

Study objectives
The aim of the study is to investigate the effects of 12 weeks of dietary supplementation with Vaccinium myrtillus (bilberries) in individuals with type 2 diabetes (T2D). Outcomes related to systemic inflammation, glycaemic regulation and cardiovascular health will be assessed at baseline and after a 12-week intervention period.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 25/03/2026, The Scientific Ethics Committees for the Central Denmark Region (Skottenborg 26, Viborg, 8800, Denmark; +45 (0)7841 0183; komite@rm.dk), ref: 1-10-72-18-26

Primary study design
Interventional

Allocation
Randomized controlled trial

Masking
Blinded (masking used)

Control
Placebo

Assignment
Parallel

Purpose
Treatment

Study type(s)

Health condition(s) or problem(s) studied
Cardiometabolic health, exercise capacity and inflammation in individuals with type 2 diabetes

Interventions
Individuals who meet all inclusion criteria and none of the exclusion criteria will, after providing both oral and written informed consent to participate in the project, be randomised according to a computer generated random sequence. Block randomisation will be performed in a 1:1 ratio to the respective intervention.

Both study participants and research staff involved in the project will be blinded to treatment allocation.

Arm 1: Dietary Intervention: Bilberry beverage.
Participants randomized to this group will be instructed to daily consume 500 ml of bilberry beverage for 12 weeks (± 7 days). The beverage contains naturally occurring bioactive compounds derived from bilberries, including polyphenols such as anthocyanins. Both the bilberry and control beverages are isocaloric and matched for taste, appearance, and mouth feel. Participants are instructed to consume the beverage daily as part of their usual routines, with the total daily intake divided into at least two doses (250 ml in the morning and 250 ml in the evening). Compliance will be assessed using two complementary methods. Participants will be asked to return any unopened beverages at the follow-up visit, with the number of unopened cartons subtracted from the total amount provided to estimate actual intake. Compliance will also be evaluated objectively by quantifying anthocyanin-derived metabolites in faecal samples collected at follow-up

Arm 2: Placebo comparator: Control beverage.
Participants randomized to this group will be instructed to daily consume 500 ml of the control beverage for 12 weeks (± 7 days). The control beverage does not contain bilberry-derived bioactive compounds but is isocaloric and matched to the bilberry beverage for taste, appearance, and mouth feel. Participants are instructed to consume the beverage daily as part of their usual routines, with the total daily intake divided into at least two doses (250 ml in the morning and 250 ml in the evening). Compliance will be assessed by asking participants to return any unopened beverages at the follow-up visit, with the number of unopened cartons subtracted from the total number provided to estimate actual intake.

Intervention Type
Supplement

Primary outcome(s)
1. Oxidized low density lipoprotein (oxLDL) measured using Mercodia Oxidized LDL ELISA kit reported in U/L at baseline and after 12 weeks of intervention (±7 days)

Key secondary outcome(s)
1. Glycated haemoglobin A1c (HbA1c) measured using whole blood and reported in mmol/mol at baseline and after 12 weeks of intervention (±7 days)

2. Glycaemic variability measured using continous glucose montitoring (CGM) at 14 days before baseline and 14 days before the end of 12 weeks of intervention (±7 days)

3. High-sensitivity C-reactive protein (hs-CRP) measured using serum or plasma and reported in mg/L at baseline and after 12 weeks of intervention (±7 days)

4. Interleukin-6 (IL-6) measured using Olink 96 Target Inflammation panel and reported in NPX (normalized protein expression) at baseline and after 12 weeks of intervention (±7 days)

5. Apolipoprotein B (ApoB) measured using serum and reported in g/L at baseline and after 12 weeks of intervention (±7 days)

6. Physical function measured using 6-minute walk test (total walking distance in metres over 6 minutes on a standardised course) at baseline and after 12 weeks of intervention (±7 days)

7. Blood pressure (systolic and diastolic) measured using a seated position after a resting period of minimum 15 minutes and reported in mmHg at baseline and after 12 weeks of intervention (±7 days)

8. Fasting plasma glucose measured using plasma after an overnight fast and reported in mmol /L at baseline and after 12 weeks of intervention (±7 days)

9. Fasting insulin measured using plasma after an overnight fast and reported in pmol/L at baseline and after 12 weeks of intervention (±7 days)

10. Fasting C-peptide measured using plasma after an overnight fast and reported in pmol/L at baseline and after 12 weeks of intervention (±7 days)

11. Homeostatic Model Assessment (HOMA) measured using fasting glucose and C-peptide at baseline and after 12 weeks of intervention (±7 days)

12. High-density lipoprotein (HDL)-cholesterol measured using serum and reported in mmol/L at baseline and after 12 weeks of intervention (±7 days)

13. Low-density lipoprotein (LDL)-cholesterol measured using the Friedewald equation from total cholesterol, HDL-cholesterol and triglycerides and reported in mmol/L at baseline and after 12 weeks of intervention (±7 days)

14. Triglycerides measured using serum after an overnight fast and reported in mmol/L at baseline and after 12 weeks of intervention (±7 days)

15. Small dense low-density lipoprotein (sdLDL)-cholesterol measured using using ELISA (Bio-Techne/NOVUS NBP2-82535 kit) on serum or plasma after an overnight fast and reported in nmol/ml at baseline and after 12 weeks of intervention (±7 days)

16. Apolipoprotein A-I (ApoA) measured using serum or plasma after an overnight fast and reported in g/L at baseline and after 12 weeks of intervention (±7 days)

17. Lipoprotein(a) [Lp(a)] measured using serum or plasma after an overnight fast and reported in nmol/L at baseline and after 12 weeks of intervention (±7 days)

18. Alanine aminotransferase (ALAT) measured using serum and reported in U/L at baseline and after 12 weeks of intervention (±7 days)

19. Aspartate aminotransferase measured using serum and reported in U/L at baseline and after 12 weeks of intervention (±7 days)

20. Alkaline phosphatase (BASP) measured using serum and reported in U/L at baseline and after 12 weeks of intervention (±7 days)

21. Bilirubin measured using serum and reported in µmol/L at baseline and after 12 weeks of intervention (±7 days)

22. Lactate dehydrogenase (LDH) measured using serum and reported in U/L at baseline and after 12 weeks of intervention (±7 days)

23. Creatinine measured using serum or plasma and reported in µmol/L at baseline and after 12 weeks of intervention (±7 days)

24. Estimated glomerular filtration rate (eGFR) measured using serum creatinine and/or cystatin C and reported in ml/min/1.73 m² at baseline and after 12 weeks of intervention (±7 days)

25. Cystatin C measured using serum or plasma and reported in mg/L at baseline and after 12 weeks of intervention (±7 days)

26. U-Albumin/creatinine-ratio measured using morning urine samples and reported in mg/g at baseline and after 12 weeks of intervention (±7 days)

27. Calcium measured using serum or plasma and reported in mmol/l at baseline and after 12 weeks of intervention (±7 days)

28. Phosphate measured using serum or plasma and reported in mmol/l at baseline and after 12 weeks of intervention (±7 days)

29. Sodium measured using serum or plasma and reported in mmol/l at baseline and after 12 weeks of intervention (±7 days)

30. Potassium measured using serum or plasma and reported in mmol/l at baseline and after 12 weeks of intervention (±7 days)

31. Markers of inflammation measured using O-link Target-96 Inflammation panel at baseline and after 12 weeks of intervention (±7 days)

32. 8-oxo-2'-deoxyguanosine (8-oxo-dG) measured using morning urine and reported in ng/ml or nmol/l at baseline and after 12 weeks of intervention (±7 days)

33. Hemostatic function: Primary hemostasis measured using ex vivo platelet aggregation in whole blood measured with impedance aggregometry (Multiplate®, Roche, Switzerland) after stimulation with adenosine diphosphate (ADP), arachidonic acid and thrombin-related activation peptide (TRAP-6). Reported in aggregation units x min. Plasma concentration of P-selectin measured with commercial ELISA (CD62P Quantikine, Biotechne, Dublin, Ireland) and reported in ng/ml at baseline and after 12 weeks of intervention (±7 days)

34. Secondary hemostasis measured using ex vivo thrombin generation (endogenous thrombin potential) in platelet-poor plasma measured using Calibrated Automated Thrombogram (BV Thrombinoscope, Maastricht, the Netherlands) after stimulation with tissue factor (reported in nM x min). Plasma concentration of prothrombin fragment 1+2, measured with commercial ELISA (EnzygnostTM, Siemens Healthineers, Ballerup, Denmark) and reported in pmol/L at baseline and after 12 weeks of intervention (±7 days)

35. Fibrinolysis measured using ex vivo fibrinolytic capacity (fibrinolysis speed) in whole blood measured with in-house modified rotational thromboelastometry after stimulation with tissue factor and tissue plasminogen activator. Unit of measure: mm/min. Ex vivo fibrinolytic capacity (time from peak fibrin to 50% lysis) in platelet-poor plasma measured with in-house turbidimetric fibrin formation and lysis assay. Unit of measure: seconds. Plasma concentrations of plasminogen activity (unit of measure: IU/L), tissue plasminogen activator (unit of measure: ng

/mL) and plasminogen activator inhibitor-1 (unit of measure: ng/mL) measured with ELISA (Technozym®, Technoclone, Vienna, Austria) at baseline and after 12 weeks of intervention (±7 days)

36. Endothelial activation measured using plasma concentrations of syndecan-1 (unit of measure: ng/ml) and thrombomodulin (unit of measure: ng/ml) measured with commercial ELISA kits (CD138 kit and CD141 kit, Diaclone, Medix Biochemica, Espoo, Finland) at baseline and after 12 weeks of intervention (±7 days)

37. Leukocyte count measured using whole blood and reported in $\times 10^9$/l at baseline and after 12 weeks of intervention (±7 days)

38. Haemoglobin measured using concentration in whole blood and reported in mmol/l at baseline and after 12 weeks of intervention (±7 days)

39. Erythrocyte mean cell volume (MCV) measured using whole blood and reported in fL at baseline and after 12 weeks of intervention (±7 days)

40. Platelet count measured using whole blood and reported in $\times 10^9$/l at baseline and after 12 weeks of intervention (±7 days)

41. Coagulation factors II, VII, and X activity measured using combined activity of coagulation factors II, VII, and X measured in plasma and reported in arbitrary units or percentage depending on assay method at baseline and after 12 weeks of intervention (±7 days)

42. International normalised ratio (INR) measured using plasma based on coagulation factors II, VII, and X activity and reported as a unitless ratio at baseline and after 12 weeks of intervention (±7 days)

43. Immature platelet fraction (IPF) measured using whole blood and reported as percentage of total platelet count (%) at baseline and after 12 weeks of intervention (±7 days)

44. Self-reported physical activity level measured using the Frändin/Grimby activity scale questionnaire and reported as categorical activity level scores based on self-reported habitual physical activity at baseline and after 12 weeks of intervention (±7 days)

45. Handgrip strength measured using a hand dynamometer and reported in kg at baseline and after 12 weeks of intervention (±7 days)

46. Sit-to-stand test measured using time required to complete five consecutive sit-to-stand repetitions from a chair without use of the arms and reported in seconds at baseline and after 12 weeks of intervention (±7 days)

47. Three-day food self-reported diary measured using the myfood24 dietary assessment platform at baseline and after 12 weeks of intervention (±7 days)

48. Circulating metabolites (plasma metabolomics) measured using metabolomic profiling of plasma samples and reported as relative or absolute metabolite concentrations depending on analytical platform at baseline and after 12 weeks of intervention (±7 days)

49. Body composition measured using bioelectrical impedance analysis and reported as body composition parameters including fat mass, lean mass, and body fat percentage at baseline and after 12 weeks of intervention (±7 days)

50. Gut microbiota composition measured using microbial profiling methods on faecal samples at baseline and after 12 weeks of intervention (±7 days)

51. Peripheral neuropathy measured using iothesiometry to assess vibration perception threshold and reported in volts at baseline and after 12 weeks of intervention (±7 days)

52. Retinal changes measured using retinal examination of the ocular fundus using standard ophthalmological assessment methods at baseline and after 12 weeks of intervention (±7 days)

53. Body composition measured using bioelectrical impedance analysis (BIA) at baseline and after 12 weeks of intervention (±7 days)

54. Postprandial glucose response during a mixed meal test measured using continuous glucose monitoring (CGM) at baseline and after 12 weeks of intervention (±7 days)

Completion date
28/02/2028

Eligibility

Key inclusion criteria
1. Diagnosed type 2 diabetes mellitus
2. Age ≥18 years
3. Written informed consent for participation

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
18 Years

Upper age limit
99 Years

Sex
All

Total final enrolment
0

Key exclusion criteria
1. Age ≥18 years
2. Daily intake of blueberries >15 g

3. Allergy or intolerance to gluten, bilberries or legumes
4. Previous randomisation in the DiaBerry study
5. Unable to provide informed consent
6. Treatment with immunosuppressive medications, including prednisolone
7. Planned initiation or modification of antidiabetic treatment during the period from 12 weeks before intervention start until completion of the intervention
8. Planned initiation or modification of lipid-lowering or cholesterol-lowering treatment during the period from 4 weeks before intervention start until completion of the intervention
9. Severe somatic or psychiatric disease rendering the participant unsuitable for participation, as assessed by the investigators

Date of first enrolment
08/06/2026

Date of final enrolment
31/12/2027

Locations

Countries of recruitment
Denmark

Study participating centre
Steno Diabetes Center Aarhus
Palle Juul Jensens Blvd 11
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Sponsor information

Organisation
Aarhus University

ROR
https://ror.org/01aj84f44

Organisation
Aarhus University Hospital

ROR
https://ror.org/040r8fr65

Funder(s)

Funder type

Funder Name
Plantefonden

Funder Name
Ekhagastiftelsen

Alternative Name(s)
Ekhaga foundation, Ekhagastiftelsen Foundation

Funding Body Type
Private sector organisation

Funding Body Subtype
Trusts, charities, foundations (both public and private)

Location
Sweden

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available