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How does a naturally high and low fibre white bread affect digestion, blood sugar and appetite?

Submission date
07/10/2026

Recruitment status
Not yet recruiting

Registration date
03/11/2026

Overall study status
Ongoing

Last Edited
03/11/2026

Condition category
Nutritional, Metabolic, Endocrine

[X] 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
The UK recommends that adults eat 30 g of fibre a day, but most people eat only about half that. Bread is a major source of fibre, yet most people choose white bread, which is low in fibre. The main fibre in white flour is called arabinoxylan. Rothamsted Research has developed wheat that is naturally higher in arabinoxylan, so white bread made from it looks and tastes like ordinary white bread but contains more fibre. This study aims to find out how eating this higher-fibre white bread for 2 weeks, compared with a lower-fibre white bread, affects digestion inside the gut, blood sugar, the gut hormones that control appetite, how full people feel and how much they eat.

Who can participate?
Healthy men and women aged 18 to 65 years with a body mass index (BMI) of 18 to 30 kg/m².

What does the study involve?
Participants first attend a screening visit with a blood test, heart tracing (ECG), blood pressure, height and weight. They then complete two study periods, one with each bread, in a random order. Participants are not told which bread they are eating. The periods are separated by at least 4 weeks.

Each period starts with a 3–4 hour morning visit. A small tube (cannula) is placed in an arm vein, participants eat two slices of bread, and blood samples and appetite questionnaires are taken over 3 hours. Breath, urine and stool samples are collected, and participants are offered a pasta meal. Participants then eat 6 slices of the study bread a day at home for 2 weeks; the bread is delivered to them.

Each period ends with a 3-day (2-night) stay at the NIHR Imperial Clinical Research Facility, Hammersmith Hospital. On Day 1, a thin, flexible tube is passed through the nose into the lower small intestine, guided by X-ray (fluoroscopy) at Charing Cross Hospital. On Day 2, a second tube is passed through the other nostril into the upper small intestine. On Days 2 and 3, participants eat set meals that include the study bread. Small samples of gut contents and blood are taken

before and for up to 3 hours after meals, and participants complete appetite questionnaires and breath tests. Urine and a daily stool sample are collected. On Day 3, the tubes are removed and participants are offered a pasta meal so that the amount they eat can be measured. Participants also complete an online food diary (Intake24) on the day before each visit.

What are the possible benefits and risks of participating?
There is no direct benefit to participants. Participants are reimbursed for their time and travel. The cannula may cause minor discomfort or bruising. The nasal tubes commonly cause temporary throat discomfort, a sore mouth, thirst, difficulty swallowing or hoarseness. Serious problems such as bleeding or damage to the gut are very rare. The X-ray procedures give a small radiation dose: about 1.62 mSv in total, similar to 9 months of natural background radiation in the UK. This adds about 0.008% to a person's lifetime risk of cancer.

Where is the study run from?
Imperial College London, at the NIHR Imperial Clinical Research Facility, Hammersmith Hospital (UK)

When is the study starting and how long is it expected to run for?
November 2026 to September 2028.

Who is funding the study?
Biotechnology and Biological Sciences Research Council (BBSRC) (UK).

Who is the main contact?
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Contact information

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Scientific, Public

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Integrated Research Application System (IRAS)
367084

Central Portfolio Management System (CPMS)
75684

Biotechnology & Biological Sciences Research Council (BBSRC) grant codes
BB/X018849/1

Study information

Scientific Title
Determining the effect of high and low arabinoxylan breads on gut content along the entire gastrointestinal tract, metabolic responses and satiety regulation

Study objectives
Primary objective:
To assess the effect of 2 weeks consumption of high-arabinoxylan (AX) versus low-AX white bread on fibre-derived metabolites produced in the small intestine, and on satiety, gut hormone responses and glucose regulation, in healthy adults.

Secondary objectives:
1. To characterise the metabolic profile of duodenal and ileal contents after high-AX versus low-AX bread
2. To compare energy intake at a subsequent ad libitum meal
3. To compare plasma and luminal metabolite profiles
4. To compare gut microbiota composition and fermentation products

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 15/10/2026, London – Queen Square Research Ethics Committee (2 Redman Place, Stratford, London, E20 1JQ, United Kingdom; Not available; queensquare.rec@hra.nhs.uk), ref: 26/LO/0701

Primary study design

Interventional

Allocation
Randomized controlled trial

Masking
Blinded (masking used)

Control
Active

Assignment
Crossover

Purpose
Basic science, Healthy volunteer study

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Oral and gastrointestinal

Interventions
This is a randomised, single-blind, two-period crossover study. Participants are randomised to the order of the two breads using Sealed Envelope, by a researcher independent of the study. Participants are blinded to bread type. The two periods are separated by a washout of at least 4 weeks.
• High-AX bread: white bread made from wheat lines that are naturally high in arabinoxylan, developed and supplied by Rothamsted Research and baked by a commercial baker.
• Low-AX bread: white bread made from wheat that is naturally low in arabinoxylan, supplied, baked and given in exactly the same way.
In each period, participants attend a short baseline visit and eat 2 slices of the allocated bread as a test meal. They then eat 6 slices a day (2 with each main meal) for 2 weeks as part of their usual diet. Each period ends with a 3-day inpatient stay at the NIHR Imperial Clinical Research Facility. During the stay, the allocated bread is served at every meal, within standardised meals matched for macronutrient content.
On Day 1 of each stay, a nasoenteric tube is placed in the ileum under fluoroscopy. On Day 2, a second tube is placed in the duodenum using the CORTRAK system. Gut contents, blood, breath, urine and stool are sampled around meals on Days 2 and 3. All tubes are removed on Day 3, before an ad libitum pasta meal.

Intervention Type
Other

Primary outcome(s)
1. Plasma glucose and insulin measured using an enzymatic method and immunoassay at Visits 1 and 3 (short baseline visits before each 2-week bread period): at –10, 0, 15, 30, 60, 90, 120 and 180 min after the bread test meal; and, Visits 2 and 4 (3-day inpatient stays after each bread period): at –10, 0, 15, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at –10, 0, 15, 30, 60 and 120 min after dinner on Day 2

2. Plasma gut hormones (ghrelin, GIP, GLP-1, PYY, CCK and OXM) measured using immunoassay at Visits 1 and 3 (short baseline visits before each 2-week bread period): at −10, 0, 15, 30, 60, 90, 120 and 180 min after the bread test meal; and, Visits 2 and 4 (3-day inpatient stays after each bread period): at −10, 0, 15, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at −10, 0, 15, 30, 60 and 120 min after dinner on Day 2

3. Subjective appetite measured using a visual analogue scales (VAS) at Visits 1 and 3 (short baseline visits before each 2-week bread period): at 0, 15, 30, 60, 90, 120 and 180 min after the test meal; and, Visits 2 and 4 (3-day inpatient stays after each bread period): at 0, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at 0, 30, 60 and 120 min after dinner on Day 2

Key secondary outcome(s)
1. Metabolic profiles of duodenal and ileal contents measured using metabolomic analysis and microscopy at Visits 2 and 4: at −10, 0, 15, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at −10, 0, 15, 30, 60 and 120 min after dinner on Day 2

2. Plasma metabolite profiles measured using metabolomic analysis at Visits 1 and 3 (short baseline visits before each 2-week bread period): at −10, 0, 15, 30, 60, 90, 120 and 180 min after the bread test meal; and, Visits 2 and 4 (3-day inpatient stays after each bread period): at −10, 0, 15, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at −10, 0, 15, 30, 60 and 120 min after dinner on Day 2

3. Urine metabolite profiles measured using metabolomic analysis at Visits 1 and 3: urine collected for 0–180 min after the test meal; and, Visits 2 and 4: urine collected throughout Days 1–3

4. Gut microbiota composition and fermentation products measured using microbiome sequencing and metabolomic analysis at Stool: on the day before Visits 1 and 3, and daily on Days 1–3 of Visits 2 and 4; and, Ileal and duodenal contents: Visits 2 and 4: at −10, 0, 15, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at −10, 0, 15, 30, 60 and 120 min after dinner on Day 2

5. Breath hydrogen measured using a breath hydrogen analyser at Visits 1 and 3 (short baseline visits before each 2-week bread period): at 0, 15, 30, 60, 90, 120 and 180 min after the test meal; and, Visits 2 and 4 (3-day inpatient stays after each bread period): at 0, 30, 60, 120 and 180 min after breakfast and lunch on Days 2 and 3, and at 0, 30, 60 and 120 min after dinner on Day 2

6. Energy intake from an ad libitum pasta meal, measured using calculated from the weight of food consumed (pre- and post-meal weighing) and the known energy content of the meal, at the end of Visits 1 and 3, and at dinner on Day 3 of Visits 2 and 4

Completion date
01/09/2028

Eligibility

Key inclusion criteria
1. Male or female
2. Age between 18-65 years (inclusive)

3. Body mass index (BMI) of 18-30 kg/m2
4. Able to understand written and spoken English
5. Willingness and ability to give written informed consent and willingness and ability to understand, to participate and to comply with the study requirements

Healthy volunteers allowed
Yes

Age group
Mixed

Lower age limit
18 Years

Upper age limit
65 Years

Sex
All

Total final enrolment
0

Key exclusion criteria
1. Participants whose screening blood results are clinically significant
2. Weight change of > = 5 kg in the preceding 2 months
3. Current smokers or individuals who vape
4. Abnormal ECG
5. History of substance abuse and/or excess alcohol intake
6. Pregnancy
7. breastfeeding
8. Diabetes
9. Cardiovascular disease
10. Having polycystic ovary syndrome (PCOS)
11. Cancer
12. Gastrointestinal disease e.g. inflammatory bowel disease or irritable bowel syndrome
13. Kidney disease
14. Liver disease
15. Pancreatitis
16. Known food allergy or intolerance that would preclude consumption of the study breads or standardised meals, including coeliac disease and wheat or gluten sensitivity
17. Started new medication within the last 3 months likely to interfere with energy metabolism, appetite regulation and hormonal balance, including: anti-inflammatory drugs or steroids, antibiotics, androgens, phenytoin, erythromycin or thyroid hormones
18. Previous nasal fractures, or surgery, obstructed nasal airway, previous bowel surgery, previous abdominal trauma
19. Any blood donation within the 12-week period prior to entering this study
20. Subjects who are unable to give informed consent by themselves
21. Subjects who are currently participating in other clinical trials

Any participants with the above conditions would already have an altered pattern of hormones and inflammatory molecules because of their disease process and would therefore give us confounding or misleading results.

Date of first enrolment
09/11/2026

Date of final enrolment
01/08/2028

Locations

Countries of recruitment
United Kingdom

England

Study participating centre
NIHR Imperial Clinical Research Facility
Hammersmith Hospital
Du Cane Rd
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London
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W12 0HS

Sponsor information

Organisation
Imperial College London

ROR
https://ror.org/041kmwe10

Funder(s)

Funder type
Government

Funder Name
Biotechnology and Biological Sciences Research Council

Alternative Name(s)
UKRI - Biotechnology And Biological Sciences Research Council, Agricultural and Food Research Council, Biotechnology & Biological Sciences Research Council, BBSRC, BBSRC UK, AFRC

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Data sharing statement to be made available at a later date